HAZARDOUS WASTE MANAGEMENT: RECENT CHANGES AND POLICY ALTERNATIVES

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NOTES

Unless otherwise noted, all years referred to in this report are calendar years. All dollar amounts are expressed in 1983 dollars, unless otherwise stated.

Details in the text, tables, and figures of this report may not add to the totals because of rounding.

PREFACE

Growing evidence indicates that improperly managed hazardous waste can threaten public health, drinking water, and the environment. To minimize these risks, the federal government regulates the disposal of newly created hazardous wastes, the cleanup of accidental chemical spills, and uncontrolled disposal sites that threaten drinking-water sources. Because these efforts are costly both to private industry and government, considerable interest exists in exploring ways to encourage safer hazardous waste management while raising needed revenue for cleaning up leaking disposal sites.

This study, prepared at the request of the Senate Committee on Environment and Public Works, examines alternative waste control strategies, such as waste taxes and other economic incentives. In keeping with CBO's mandate to provide objective analysis, the report makes no recommendations.

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Director

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SUMMARY

Although the link between exposure to industrial hazardous waste and human health is only imperfectly understood, the risks of improper waste disposal are deemed dangerous enough to require government action closing the pathways of exposure. The federal government now regulates both the management of newly created hazardous waste and the cleanup of accidental waste spills and disposal sites that threaten drinking-water sources. These efforts have been costly for private industry--which paid between $4.2 billion and $5.8 billion in 1983 to treat and dispose of its hazardous residuals--and for federal and state governments--which spent over $700 million in 1983 for program administration and site cleanup. Because these costs will rise significantly over the next 10 years, it is clearly advantageous to reduce the overall generation of toxic waste and to promote treatment technologies that reduce or eliminate its hazards.

Accordingly, the development and implementation of a long-term solution to the nation's hazardous waste problem is of paramount concern to federal and state governments. Following important changes to hazardous waste laws in 1984, the Congress now is considering further refinements to the federal system for hazardous waste management. In view of these activities, this study:

- Examines the current picture of hazardous waste generation, management, and costs;
- Evaluates recent changes to the federal law regulating hazardous waste; and
- Analyzes additional options for improving federal regulations, with an emphasis on taxes on wastes and their feedstock precursors.

This study does not compare the effectiveness of the federal system for hazardous waste management with other programs to protect public health. Instead, the options examined in this paper address three Congressional objectives: reduction or elimination of the generation of hazardous waste; effective treatment, storage, and disposal of hazardous waste to eliminate the possibility of future problems; and provision of sufficient fin-

ancial resources to support government action protecting public health and the environment from uncontrolled waste disposal sites, toxic waste spills, or other hazardous discharges.

CURRENT PICTURE OF HAZARDOUS WASTE GENERATION AND MANAGEMENT

Over 99 percent of the nation's hazardous waste is generated by U.S. industries as residuals to basic manufacturing processes. These wastes are either stored for future processing; recycled, treated, and disposed of permanently; or released directly into the environment. Considerable uncertainty surrounds the exact amount of hazardous waste that is managed in an environmentally sound manner. To obtain a nationwide picture of how much waste is generated and how it is managed, CBO developed a simulation model based on published surveys and other data sources concerning hazardous waste generation and management.

These modeling efforts reveal two important conclusions about recent treatment and disposal practices. First, U.S. industries generated about 266 million metric tons (MMT) of hazardous waste in 1983, and the majority of this waste was deposited in or on the land, using technologies that often are inadequate to prevent groundwater contamination. These disposal sites could eventually require cleanup at costs 10 to 100 times those that would have been incurred if safer, but more expensive, alternatives had been used originally. Second, without considering tax benefits available to industry, CBO estimates that U.S. industries spent from $4.2 billion to $5.8 billion in 1983 to treat or dispose of their hazardous waste. The chemicals and allied products and primary metals industries were the two largest waste generators and bore the largest share of these costs.

In addition, other studies have pointed out that a large number of unsafe hazardous disposal sites now exists and that the expected costs of cleanup greatly exceed the resources currently devoted to the problem. These studies also indicate that both the number of uncontrolled waste disposal sites and the average cost of restoring them are growing. The Environmental Protection Agency (EPA) believes that from 1,400 to 2,200 waste sites could eventually require cleanup. Using similar criteria to identify priority cleanup candidates, the Office of Technology Assessment (OTA) estimates that as many as 10,000 uncontrolled waste disposal sites could need to be remedied. Depending on the actual number of sites restored and pace at which they are cleaned up, the costs of these remedial activities could range from $10 billion to $100 billion. In light of these concerns, the Congress is now considering the future scope of and funding for Superfund, the program responsible for site cleanup.

This study employs a broad definition of hazardous waste. It includes all liquid and solid waste streams now regulated or proposed for regulation under federal hazardous waste laws, as well as some hazardous substances and treated industrial residuals released directly into waterways. The CBO hazardous waste coverage, therefore, is larger than the group of hazardous substances reported in previous surveys by the EPA. For example, this study includes waste oils, industrial scrubber sludges, and air pollution control dusts, which are not currently regulated under the Resource Conservation and Recovery Act, as amended.

FEDERAL RESPONSE

Although a number of laws, such as the Clean Air Act, Clean Water Act, and Safe Drinking Water Act, contain individual provisions that regulate hazardous discharges, the federal system for hazardous waste management consists essentially of two major parts. One component--the Resource Conservation and Recovery Act (RCRA) and its 1984 amendments--regulates the management and disposal of currently generated hazardous waste. The other--the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)--finances cleanups of abandoned or uncontrolled waste disposal sites. The objective of both laws is to minimize the release of hazardous substances both in the near and long term. To be successful therefore, the waste management system should expedite restoration of old problem sites, while instituting measures that would reduce waste production and lower the probability of creating new problem sites.

The Resource Conservation and Recovery Act

The RCRA, first passed in 1976, establishes guidelines for the management of hazardous waste--from its initial generation to final disposal. Facilities that treat, store, or dispose of wastes identified as hazardous by the EPA must obtain operating permits that certify compliance with minimum waste management standards. Currently, most of these facilities are operating under interim approval, a level of regulatory control that does not assure proper waste management. An estimated 4,000 facilities must either receive final EPA approval or be closed.

Because of the large scope of the waste management problem (virtually all manufacturers generate some quantity of hazardous waste), the EPA has chosen to regulate only certain wastes and waste management practices that states or scientific experts consider hazardous. As a result, many types of excluded wastes are deposited in unregulated facilities, posing possible health risks to neighboring populations and increasing the potential need for future cleanup activities. In addition, basic regulations, first promulgated in 1980, have not discouraged the use of inexpensive land disposal technologies, despite evidence of their contamination of groundwater.

In response to these concerns, the Congress passed major revisions to the RCRA in 1984. The amendments were designed to close existing regulatory loopholes, to promote more widespread recycling of hazardous materials, and to reduce industrial use of land disposal technologies. Perhaps the most direct step toward achieving these goals was a set of prohibitions against the land disposal of certain types of wastes. Because such prohibitions raise the cost of waste disposal--by limiting the choices of disposal methods to more expensive, advanced techniques--they potentially encourage waste reduction measures by private industry. For these reasons, under the most optimistic assumptions regarding industry's ability to reduce waste production, waste generation in the aggregate could fall by up to 14 percent by 1990. But, if industry does not alter waste production rates, the volume of waste generated could grow by 6 percent--from 266 MMT in 1983 to 280 MMT in 1990.

Cost of 1984 RCRA Amendments to Private Industry. The CBO estimates that the 1984 RCRA amendments could increase industrial compliance costs from between $4.2 billion and $5.8 billion in 1983 to between $8.4 billion and $11.2 billion in 1990, depending on the level of waste reduction achieved by industry. The use of available tax benefits by individual firms, such as investment tax credits and accelerated depreciation of capital equipment--neither of which were considered in this analysis--could reduce total industrial compliance costs significantly. Moreover, this study suggests that industries which achieve a high degree of waste reduction could actually experience declining compliance costs by 1990. For example, the fabricated metal products group could, through maximum waste reduction efforts, lower its total compliance costs from $899 million in 1983 to $735 million in 1990.

Certain industry groups, such as wood preserving and primary metals, might be particularly burdened by the new law's requirements. Estimated incremental hazardous waste expenditures could rise as high as 111 percent of expected profits for wood preservers and 64 percent for primary metals producers, if no waste reduction measures were employed. Even for these industries, however, full exploitation of their waste reduction potential could lower incremental compliance costs to 16 percent and 25 percent of expected profits, respectively.

Industry's reduction of waste generation in response to the greater costs of management depends largely on whether the new land disposal requirements in the 1984 amendments are implemented fully. Although the EPA has begun to develop regulations for some of the act's many new requirements, a large number of regulatory and administrative actions have not yet been implemented. Because the land disposal prohibitions can be waived for up to two years if alternative treatment methods are unavailable or if firms can show hardship, concern exists about whether these and other requirements of the 1984 amendments will take effect according to the timetable set forth by the Congress. Thus, even if many new provisions are implemented on schedule, the act could fall short of its goal of promoting waste reduction. Additional measures might, therefore, be necessary to provide stronger incentives for waste reduction, to ensure the availability of alternative waste management technologies, and to reduce the costs of industrial compliance so that industry can invest in new treatment and disposal capacity.

The Superfund

Remedying the public health threats from hazardous wastes released into the environment is the intent of the Comprehensive Environmental Response Compensation and Liability Act of 1980, or "Superfund"--the second major component of the federal hazardous waste management system. Financed primarily by a tax on petroleum and chemical feedstocks, the Superfund program establishes broad federal authority to abate releases of certain hazardous substances, including air emissions, accidental spills, and leaking landfills. In practice, most of Superfund's resources have been devoted to cleaning up about 800 priority hazardous waste disposal sites, identified by the EPA as posing a threat to health and the environment. Restoring all these sites (and up to 9,200 additional priority sites estimated by OTA) will be expensive. Estimates range from $10 billion to $100 billion, greatly exceeding the maximum fund level of $1.6 billion. Moreover, authorization for the Superfund program expires this year, with only a fraction of identified priority waste sites cleaned up. In considering this program, the Congress faces important issues about the need for additional site cleanups, the pace of restoration, the role of the states in supporting the program, and alternative approaches for financing the fund. Two other recent studies addressed the first three concerns.[1] This paper analyzes alternative

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[1] See Office of Technology Assessment, *Superfund Strategy* (March 1985); and General Accounting Office, *Cleaning Up Hazardous Wastes: An Overview of Superfund Reauthorization Issues*, RCED-85-69 (March 29, 1985).

Superfund financing options--the final, but perhaps most important concern of the Congress.

OPTIONS FOR CHANGE

The 99th Congress is now considering options to improve the existing federal waste management system. An Administration proposal, S. 494, would raise $5.3 billion over five years through continuation of the existing tax on crude oil and certain petrochemicals (the so-called "feedstock" tax) and the institution of a variable unit tax on waste disposal methods. Other proposals under consideration seek to raise higher amounts through various taxing mechanisms. In general, the Congress must address three different, but not mutually exclusive, policy goals:

- Encourage waste reduction at the point of production, thereby furthering one of the basic goals of current legislation;
- Raise revenues to enable continued cleanup under the Superfund law; and
- Reduce the government's burden of implementing the 1984 RCRA amendments, as well as ease the financial and institutional constraints to new waste management capacity that will be needed once the land disposal prohibitions take effect.

The effects of different measures to achieve these goals are presented in Summary Tables 1 and 2 and discussed below.

Waste-End Taxes To Encourage Management Changes

Imposition of variable unit taxes on waste generated or disposed of (so-called "waste-end" taxes) could spur industry to make desirable changes in waste management practices and to reduce waste generation in order to lower total compliance costs. By use of a graduated tax on undesirable combinations of hazardous wastes and disposal technologies, previously higher-cost, but safer, technologies could become more attractive relative to taxed, but less safe, disposal methods. These induced shifts in waste management would support the regulatory changes--such as reductions in the use of land disposal technologies--intended by the 1984 RCRA amendments. In addition, graduated waste taxes, in combination with the more stringent RCRA requirements, could encourage industry to reduce aggregate

SUMMARY TABLE 1. EFFECTS OF RCRA, THE 1984 AMENDMENTS, AND ALTERNATIVE POLICIES

Alternative	Annual Cost to Industry (In billions of 1983 dollars)	Annual Cost to Federal Government (In millions of 1983 dollars)	Effect on Waste Reduction	Effect on Waste Management Practices
1983 Baseline (1976 RCRA)	5.8	175	Negligible incentives for waste reduction; 266 million metric tons (MMT) generated in 1983; could increase to nearly 280 MMT by 1990.	Encourages land disposal.
1984 Amendments	8.4-11.2	235	Limited incentives because of regulatory uncertainty; 1990 waste generation estimated at 229 MMT-280 MMT.	Discourages or bans land disposal of high priority wastes. Increases incineration and pretreatment of wastes before land disposal.
1984 Amendments Plus Waste-End Taxes	9.0-13.9	0-235 [a]	Strong incentives from increased cost of waste disposal; 1990 waste generation estimated at 229 MMT.	Encourages waste recycle, recovery, and resale first; waste destruction second; waste hazard reduction third. Supports waste management shifts intended by land disposal bans of 1984 amendments.
1984 Amendments, Waste-End Taxes, Plus Additional Improvements such as Accelerated Research and Development, Capital Formation Assistance, Increased Enforcement Efforts, and Deposit/Refund System for Certain Wastes	9.0-13.9	0-335 [a]	Strong incentives from increased cost of waste disposal, information transfer, and enhanced enforcement; 1990 waste generation estimated at 210 MMT.	Deposit/Refund system encourages waste handling; encourages waste management hierarchy as above; supports waste management shifts intended by land disposal bans of 1984 amendments.

a. Cost to federal government depends on degree to which revenues are dedicated to federal administrative expenses.

SUMMARY TABLE 2. EFFECTS OF ALTERNATIVE REVENUE SOURCES ON SUPERFUND FINANCING

	Estimated Revenues (In millions of 1983 dollars)			
Alternative	Year One (1986)	Year Five (1990)	Annual Beyond Year Five	Comments
Feedstock Tax	250[a]	250	250	Stable revenue source; easy to administer, but limited tax base.
Waste-End Taxes	600-2,700	500-1,300	400-1,000	Revenues less certain over time because of erosion of tax base; harder to administer, but broader tax base.
Corporate Receipts Tax	100	500	500	Stable revenue source; easy to administer; broader tax base than feedstock tax; but might include low waste-producing industries.
Cost Recovery	25	100	100	Limited revenue potential; relies on judicial process.
Private Contributions	40	40	40	Uncertain revenue potential; no admistrative costs.
General Revenues	44 [b]	44 [b]	44 [b]	Significant revenue source; distributes costs to the general public.

a. Current level of revenues.

b. Assumes reauthorization in 1986 at current contribution level.

waste generation from 266 MMT in 1983 to 229 MMT in 1990. In contrast, a flat tax on all hazardous wastes and disposal methods might encourage waste reduction but not necessarily management shifts (see Summary Table 1).

In addition to the advantages of waste-end taxes in achieving RCRA's goals, the revenues they raise could be used to fund Superfund activities, to support administrative costs, or to relieve financial constraints on building new waste management facilities. The waste-end taxes examined in this study would generate from $600 million to $2.7 billion in the first year of implementation, declining to between $500 million and $1.3 billion by 1990. Revenues would decline over time both because of reduced rates of waste generation and because of shifts from highly taxed management techniques to ones bearing lower tax rates. Falling revenues, therefore, would indicate that a waste-end tax had succeeded in reducing waste output. Although the costs to industry of alternative tax systems would be significant in some cases, at most they would exceed the projected costs of the 1984 RCRA amendments by 30 percent. In fact, the tax systems could actually lower total compliance costs for those industries that chose to reduce waste generation in response to the tax.

One significant implementation problem of a new tax system would be the need for reporting. Although no such requirements now exist under RCRA, reporting of waste quantities is a standard feature under other environmental protection programs. In addition, like many tax systems, waste-end taxes could encourage tax evasion, in this case through illegal disposal of hazardous wastes or underreporting of quantities.

Superfund Revenue Options

Several alternative funding sources exist for extending the Superfund cleanup program: waste-end taxes, feedstock taxes, corporate receipts taxes, recovery through litigation, private contributions, and general revenues. Alternatives differ largely by their administrative simplicity and revenue stability (see Summary Table 2). These options are designed to raise at least $1 billion annually. (The amount that EPA can spend effectively for Superfund cleanup activities has been estimated at $1.0 billion to $1.2 billion per year.) Because the growing number of priority cleanup sites could require financial resources beyond those reasonably available under either a feedstock or waste-end tax system, a well-timed combination of several alternatives could best provide a stable, long-term source of revenues for Superfund.

Among the alternatives, waste-end taxes were found to provide ample funding for Superfund for the 1986 to 1988 period, with less stable revenues thereafter, as the level of waste generation drops. For more stable revenues over time, either an increase in the current feedstock tax on petrochemicals, the institution of a tax on net corporate receipts, or the use of general revenues might be preferable. A doubling of current feedstock tax rates would raise about $500 million per year. Alternatively, a tax of 0.0275 percent on U.S. companies with net corporate receipts of greater than $5 million would yield the same amount. But, by taxing some companies that do not directly produce hazardous wastes, opponents argue that these two alternatives might be less equitable than waste-end taxes, which better match the costs of cleanup with waste producers.

Assessing waste-end taxes only approximates the relationship between past waste-generating activities and future Superfund sites, however. Because this match can never be perfect, others note that the most equitable funding source for the public problem of waste cleanup is general revenues. In this way, consumers that benefited in the past from lower prices on waste-generating products would bear the costs of cleanup.

Finally, two additional revenue sources--private contributions to the Superfund and cost recoveries for the fund through settlements or lawsuits--might have only limited revenue potential.

Other Measures

The Congress might wish to institute certain other programs designed to assist industry and government agencies in meeting the new requirements of the 1984 RCRA amendments. These measures could be undertaken regardless of decisions about using waste-end fees or other revenue mechanisms to support Superfund. They also could be combined to good advantage with the broader revenue options. Such measures, which could be funded by small unit waste taxes, include:

- Accelerated research and development in advanced waste and hazard reduction measures to help achieve even greater levels of public health protection and environmental safety. (A $0.02 per metric ton waste tax could supply roughly $5 million per year; in 1986, by comparison, virtually no such research will be supported by the EPA.)

- Capital formation assistance to enable investment in new treatment facilities, especially by small companies, to lower the chance of capacity shortages stemming from the land disposal prohibitions in the 1984 RCRA amendments. (A \$0.26 per metric ton tax could support a \$300 million subsidized loan program; none is now provided.)

- Increased enforcement efforts, such as more frequent facility inspections, to ensure regulatory compliance with the 1984 RCRA amendments. (A \$0.10 per metric ton tax would more than double 1985 funding levels for EPA enforcement--to \$26 million.)
- Institution of a deposit/refund system to promote recycling of easy to recover wastes, such as solvents or waste oils. (Projected costs could be covered by revenues from lost deposits.)

CONCLUSION

Considering the important steps already taken to control hazardous wastes in the environment, the Congress might wish to consider measures to improve and consolidate the existing federal waste management system. While additional measures might involve changes to the Resource Conservation and Recovery Act, they would more certainly require changes to the Superfund law.

The results of CBO's examination indicate that waste-end taxes would go far to encourage lower hazardous waste production and to support the waste management shifts intended by the 1984 RCRA amendments. Moreover, they would provide a level of revenue that could aid the Superfund program substantially--at least for a short period. Because a successful waste-end tax would yield declining revenues over time, however, either an increase in the current feedstock tax, the institution of a tax on net corporate receipts, or the use of general revenues would provide an adequate and more certain funding level for an expanded (up to \$1 billion to \$2 billion per year) Superfund in the long run. Under any circumstances, recent changes to the current RCRA, potential changes under Superfund, and other options considered in this study all promise to increase greatly the industrial cost of waste management in the coming decade.

CHAPTER I

INTRODUCTION

Each year, U.S. industries generate substantial quantities of solid wastes as residual materials from basic manufacturing processes. Among these wastes are hazardous materials that pose present or potential dangers to human health and the environment. Uncontrolled disposal of such wastes on land already has caused significant groundwater contamination in some areas, and threatens eventual pollution at many other disposal sites.

National concern about these public health risks led to two federal laws:

- The Resource Conservation and Recovery Act of 1976, or RCRA, to regulate the management and disposal of newly created hazardous wastes; and
- The Comprehensive Environmental Response, Compensation and Liability Act of 1980, or Superfund, to establish a fund to finance cleanup of waste spills and uncontrolled disposal sites for hazardous waste.

Together, these acts form the basis of federal activities to protect public health and the environment from contamination--past, present, and future--caused by improper handling of hazardous industrial residuals. Both programs are in their early stages. An estimated 4,000 active facilities for hazardous waste management must still receive final permits under RCRA, and as many as 10,000 inactive hazardous waste sites may require expensive cleanup under Superfund. Effective hazardous waste management remains a costly and difficult environmental challenge.

RISKS ASSOCIATED WITH HAZARDOUS WASTE GENERATION AND DISPOSAL

Past and present practices for hazardous waste disposal have created substantial risks for public health and the environment. These risks can be acute--as when 60,000 drums of hazardous wastes caught fire at the Chemical Control site in Elizabeth, New Jersey--or insidious--as at Love Canal, New York, where toxic chemical wastes leached from an abandoned dump site and seeped into the basements of nearby houses and into the Niagara River. Residents in Love Canal were exposed to toxic chemicals for several years before discovering the chemicals' presence. 1/ In such a case, the full extent of victims' injuries, if any, may not be known for 10 to 20 years, because many chronic diseases--such as cancer, heart disease, neurological disorders, and reproductive problems--have long latency periods.

Since the Love Canal incident, increasing evidence of land and water contamination from toxic dump sites, pesticide applications, and chemical and gasoline storage tanks has been documented. 2/ But the unknown risks could be even greater. The Environmental Protection Agency (EPA) believes that more than 90 percent of the estimated 180,000 surface impoundments (essentially waste holding ponds) are designed and located in a manner that could result in groundwater contamination. In addition, despite the fact that only a small fraction of the nation's 12 million to 14 million private drinking-water wells have been tested for toxic constituents, individual wells in at least 40 states have been closed because of contamination. Experts agree that further testing will inevitably lead to more well closures.

While the presence of waste contaminants has been well-documented in many areas, the actual health risks posed by such wastes vary in each case with the waste itself, the disposal method used, and the degree of human exposure. Groundwater contamination presents only limited human health risks if the contaminated area is located far from population centers and is not used (or likely to be used) in the future as a drinking-water source. Similarly, wastes with relatively small potential health risks (on a per unit basis relative to higher hazard wastes, such as known carcinogens) can cause significant health problems only if large volumes of the waste are permitted to reach public water supplies. Those treatment and disposal methods that minimize the chances of human exposure to hazardous wastes are, therefore, preferred.

But considerable uncertainty surrounds the exact amounts of hazardous wastes that are managed and disposed of in an environmentally sound

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1. See Congressional Research Service, *Six Case Studies of Compensation For Toxic Substances*, prepared for Senate Committee on Environment and Public Works, Report No. 96-13 (June 1980), pp. 43-44.

2. See, for example, Office of Technology Assessment, *Protecting the Nation's Groundwater from Contamination* (1984). More recently, a survey performed by House Committee on Energy and Commerce staff found some indication of groundwater contamination at 559 of 1,246 RCRA disposal facilities surveyed. See *Washington Post*, "Tainted Groundwater Indicated at 559 Dumps," April 29, 1985.

manner. Thousands of sites inappropriately used for hazardous waste disposal have been closed and abandoned by their former owners or operators. Sites with such characteristics could eventually be cleaned up with Superfund money, if no responsible parties can be identified. Because the current backlog of sites is so large, however, it seems inevitable that some will not be cleaned up in time to prevent significant contamination of groundwater or other natural resources.

Even wastes generated and managed under current federal and state regulations pose risks to the environment through the prevalent use of inexpensive land disposal technologies in most areas. [3] Some 45 inactive hazardous waste sites that were regulated by RCRA have already been designated as Superfund cleanup candidates. Additional RCRA-regulated facilities are expected to close, rather than meet upgraded performance standards. Landfills and surface impoundments threaten eventual groundwater contamination, unless expensive monitoring and leachate collection systems are scrupulously maintained well beyond the usual 20-year operating life of such facilities. The costs of cleaning up those waste management facilities that do fail in the long term could then revert to the federal government. [4]

Considering the uncertain long-term effectiveness of many treatment technologies and disposal methods, the advantages of reducing the production of hazardous residuals and promoting treatments that reduce or eliminate the hazards caused by these substances are clear. The Congressional Budget Office (CBO) estimates that about 266 million metric tons (MMT) of hazardous wastes were generated by U.S. industries in 1983, and that hazardous waste generation will grow by about 1 percent per year through 1990 without regulatory changes. Although increased quantities of hazardous wastes will not further degrade the environment if managed properly, doing so will be expensive. Further, adequate treatment of the millions of tons of hazardous residuals produced annually is not assured. For these reasons, the primary goal of current federal legislation for waste manage-

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3. The preamble to EPA's land disposal regulations states that "most land disposal units, however well designed, will eventually leak after closure to some extent." *Federal Register*, vol. 47, no. 143 (July 26, 1982).

4. Under the requirements of the Post-Closure Liability Trust Fund set up under the Superfund act, the fund (that is, the federal government) assumes full liability for hazardous releases five years after closure of a facility permitted under RCRA regulation. The federal government would, therefore, be responsible for cleaning up environmental problems caused by the facility after this period. Unlike the main $1.6 billion Superfund, which is funded by taxes on certain petrochemicals, federal appropriations, and other means, the Post-Closure Fund is financed by a small ($2.13 per dry weight ton) tax on hazardous wastes disposed at RCRA facilities.

ment is to reduce the generation of hazardous waste as expeditiously as possible. Waste that cannot be prevented must be managed to minimize its present and future threat to the environment.

FEDERAL RESPONSE TO DATE

Before passage of RCRA, hazardous wastes generally were disposed of in the least expensive manner--in or on the land. These inadequate disposal methods failed to account for the long-run costs to society of detecting and restoring contaminated sites once wastes had seeped into the groundwater. By one recent estimate, the cost of cleaning up uncontrolled hazardous waste sites is typically 10 to 100 times greater than the cost of originally treating the wastes in the most effective fashion. 5/ Federal regulation of hazardous waste is designed to correct this divergence between the private sector and social costs of waste management, so that society's demand for waste-intensive products will be based on the full costs that such industrial activity imposes on society. Requiring the proper management of newly generated hazardous wastes over their entire life cycle in the environment could, therefore, be cheaper in the long run than having to remedy the problems of improper waste disposal.

As noted, federal legislation now exists to regulate the disposal of newly generated hazardous wastes and to clean up abandoned hazardous waste sites. Under the RCRA program, more than 400 specific streams of waste have been listed for regulation, and a "cradle-to-grave" tracking system has been instituted to ensure that wastes shipped off-site are managed at treatment, storage, and disposal facilities with EPA permits to operate.

Under the Superfund program, the EPA has begun to identify and clean up abandoned waste sites. Through fiscal year 1984, the EPA had completed 10,700 preliminary assessments for the roughly 19,000 potential hazardous waste sites now in the agency's inventory. The EPA uses these assessments to rank the potential dangers posed by each site and then assigns those in the most urgent need of cleanup to the National Priorities List (NPL). Under the Superfund program, only designated NPL sites are eligible for federal remedial action funds. (Cleanups of any site not on the NPL must be funded by state, local, or private money.) Of the almost 800 sites on or proposed for the NPL, only six have been fully restored.

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5. Office of Technology Assessment, *Technologies and Management Strategies for Hazardous Waste Control* (1983).

Largely because of the enormous scope and complexity of the hazardous waste problem, considerable need exists to improve the existing RCRA waste management system. Many confirmed and potentially hazardous types of waste (certain pesticides and organic materials) are not regulated. Regulatory loopholes also have arisen. For example, firms that generate small quantities of hazardous wastes can escape management requirements. Hazardous wastes mixed with fuel oils can be burned and released into the environment without adequate controls. Certain potentially dangerous waste management practices, such as the injection of wastes directly into underground drinking-water sources, have been inadequately controlled because of EPA and states' limited enforcement efforts under the Safe Drinking Water Act.

The size of the problem has also placed an enormous administrative and enforcement burden on the EPA and on states authorized to manage the federal regulatory program. For example, over one-half of regulated hazardous waste management facilities have been reported out of compliance with RCRA groundwater monitoring requirements, and a seven-year permit backlog now exists. [6] Recent amendments to RCRA, which seek to close many of these loopholes, will significantly increase these shared responsibilities.

COSTS ASSOCIATED WITH HAZARDOUS WASTE MANAGEMENT AND REGULATION

The national bill for hazardous waste management and cleanup easily exceeds $6 billion annually, and is distributed among federal and state governments, private industry, and private citizens. Future costs are likely to be far higher because of new regulatory requirements under RCRA and because not all uncontrolled waste sites have been identified and cleaned up as intended under Superfund.

Federal costs will be quite significant, if only because of rapid growth in the projected scope and costs of the Superfund cleanup program. Each contaminated Superfund site typically costs $5 million to $10 million to restore, with recent projections for cleanup of already identified hazardous waste sites ranging from $10 billion to $100 billion. [7] The future federal contribution to Superfund remedial efforts could easily exceed the current $44 million appropriated annually for this purpose. [8] Concurrently, regulation of newly generated hazardous wastes under RCRA has grown quickly to become the third largest EPA operating program, with an annual budget of about $175 million. (EPA has requested $235 million for fiscal year 1986.) Not included in the EPA budget are the costs to federal agencies of managing their own wastes, estimated at $420 million annually. In addition, states spend at least $82 million per year for both site cleanup and hazardous waste regulation. No reliable estimate even exists for the potential costs of future environmental problems caused by RCRA-regulated facilities, although eventual releases of hazardous materials from land disposal sites are highly probable.

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[6] See General Accounting Office, *Interim Report on Inspection, Enforcement, and Permitting Activities at Hazardous Waste Facilities*, RCEO-83-241 (September 21, 1983).

[7] See Office of Technology Assessment, *Superfund Strategy* (March, 1985).

The private sector's costs of regulatory compliance also are considerable. The CBO estimates that the 70 major waste-generating industries spent between $4.2 billion and $5.8 billion in 1983 to comply with federal and state hazardous waste management requirements. [9] Waste management has now become an important production concern, especially because of the large potential legal liabilities associated with improper waste handling. As a result, industries generally desire a well-enforced regulatory program applied equally to all waste generators. Similarly, certain major waste-generating industries (chemicals and petroleum, for instance) believe that the costs of restoring contaminated waste sites should be spread more evenly among generators than under the current Superfund financing scheme.

One final set of private costs that are often ignored involves medical expenses incurred by individuals exposed to hazardous substances. No reliable national estimate of these costs is now available, partly because pollution victims might not have discovered their injuries as yet because of the long latency periods of these diseases. [10] It is expected, however, that such medical and associated legal costs are large and growing. Individuals exposed to chemicals at Love Canal, for example, were recently awarded a

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8. For example, the House of Representatives passed a bill (H.R. 5640, 98th Congress) in August 1984 that would have increased the federal Superfund annual appropriation by 10 times the current level.

9. Some of these compliance costs also result from requirements of the Clean Water Act with regard to discharges of toxics and metals into surface waters and public sewer systems. See Chapter II for details on the estimation procedure.

10. In addition to difficulties in discovering actual injuries, pollution victims could face other barriers to legal recovery, such as proving that exposure to hazardous substances was the sole cause of the injury. See, for example, Jeffrey Trauberman, "Compensating Victims of Toxic Substances: Existing Federal Mechanisms," *Harvard Environmental Law Review*, vol. 5, no. 1 (1981).

$20 million settlement. Although no legislation has yet been passed, recent Congressional proposals would provide for an administrative compensation scheme to deal with such concerns. 11/

ISSUES CONCERNING HAZARDOUS WASTE CONTROL

With the 1984 RCRA amendments (Public Law 98-616), the Congress closed many significant regulatory loopholes that had allowed certain hazardous wastes or waste management practices to remain uncontrolled. Most significant is the act's prohibitions on the land disposal of certain hazardous wastes, which are to take effect over the next six years. Despite these changes, however, a number of issues pertinent to the federal system for hazardous waste management still must be resolved. They include the following:

- Provide regulatory requirements or economic incentives for industry to reduce the quantity of waste it generates through changes in plant production processes, recycling of waste materials, or volume reduction technologies;
- Ensure that remaining wastes are disposed of in an environmentally sound manner to protect public health and the environment and to reduce the chances that RCRA-regulated waste disposal sites will become future Superfund cleanup candidates;
- Develop reliable revenue mechanisms to fund federal and state waste management and cleanup efforts; and
- Reduce the short- and long-term costs of proper hazardous waste management to government and private industry.

This paper analyzes alternative strategies that offer promise in strengthening the existing federal waste management framework, either by reducing the total volume of waste generated and managed (as a proxy for hazard reduction) or by restricting the use of risky disposal methods. While the Congress previously has emphasized prohibition of the most hazardous disposal methods, recent amendments to RCRA affirm as national policy the reduction of hazardous waste generation as expeditiously as possible.

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11. S. 51, as adopted by the Senate Committee on Environment and Public Works on March 1, 1985, would establish a two-year, $60 million demonstration program for victim assistance. H.R. 5640 (passed by the House of Representatives in the 98th Congress) would have created a legal mechanism enabling victims to seek compensation for personal injury from abandoned waste disposal sites.

This view is shared by current proposals in the 99th Congress that seek to limit the quantities of waste generated by means of taxes either on the production or on the disposal of hazardous wastes or the chemical feedstocks associated with waste production. An Administration proposal (S. 494) intends to raise $5.3 billion over five years through continuation of an existing tax on crude oil and certain petrochemicals and the institution of a variable tax on waste disposal methods. Other proposals under consideration, such as Senator Stafford's bill (S. 51), would raise still higher amounts through various taxing mechanisms. These proposals have particularly emphasized waste taxes because using economic incentives to encourage the reduction of generated wastes is believed to be a somewhat more certain strategy to reduce risks than determining which types of disposal techniques will ultimately be safe. In addition, the revenues generated by these taxes are considered an appropriate source of funds for the large Superfund cleanup efforts to which the federal government is now committed. This analysis, therefore, focuses on the proposed use of waste taxes. Specifically, it examines the possible effects of various tax schemes on the volume of wastes produced and on the choice of disposal techniques, and estimates the potential revenues that the tax systems could generate if they were instituted.

CHAPTER II

HAZARDOUS WASTE GENERATION, TREATMENT, AND DISPOSAL: THE RECENT PICTURE

The Congressional Budget Office estimates that industry generated roughly 266 million metric tons (one metric ton is equivalent to 2,200 pounds) of hazardous waste in 1983 and paid about $5.8 billion to dispose of this waste. Some of the waste was neither regulated by hazardous waste laws nor disposed of in an acceptable manner. These continuing problems led to passage of the Hazardous and Solid Waste Amendments of 1984. 1/ In fiscal year 1984, the federal government disbursed about $285 million under the Superfund program to mitigate the effects of hazardous substance spills and to clean up old waste sites that threatened public health. Many such sites remain and significant additional resources will be needed to restore them. The Congress will consider these issues when it reviews the Superfund legislation in 1985.

This chapter profiles hazardous waste generation and management practices before passage of the 1984 RCRA amendments. This information provides a useful "baseline" from which to assess changes resulting from the 1984 amendments as well as effects of other policy alternatives, which are discussed in Chapters III and IV, respectively.

WHAT CONSTITUTES HAZARDOUS WASTE

Under authority granted in the Resource Conservation and Recovery Act, the Environmental Protection Agency defines hazardous waste in two ways. First, generic substances are considered hazardous if they exhibit certain characteristics--such as ignitability, corrosivity, reactivity, or toxicity (taking into account the potential for human exposure to toxic substances). Tests for these characteristics are stipulated in EPA regulations. Second, the EPA lists as hazardous some 400 substances by name, including common industrial waste streams containing hazardous spent solvents and specific chemicals. These EPA categories, however, do not encompass all substances considered hazardous to human health. For example, EPA's toxicity test

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1. This legislation amended the Resource Conservation and Recovery Act of 1976 and hereafter is referred to as the 1984 RCRA amendments.

only identifies ten toxic heavy metals and four pesticides, excluding dioxin and other toxic wastes. Many wastes that contain toxic organic constituents that have not been identified by EPA by name have therefore been excluded.

Many types of regulatory exemptions and exclusions also exist. First, the RCRA itself exempts certain solid wastes from coverage, such as sewage and industrial effluents regulated under the Federal Water Pollution Control Act. Second, it temporarily excludes other wastes, such as oil and gas drilling muds and mining wastes, pending further EPA study. Third, general exemptions are provided for household wastes; for small quantity generators (originally fewer than 1,000 kilograms a month, now fewer than 100 kilograms a month); and for residues of hazardous wastes in empty containers.

Further complicating the problem of defining hazardous waste are the many state definitions. Under their own hazardous waste control programs, states are allowed to add substances to the EPA list of wastes. For example, 16 states consider polychlorinated biphenols (PCBs) a hazardous waste and 14 states list waste oils, neither of which is considered hazardous by EPA's current standards. Several states also have expanded the EPA's definition of waste by developing additional toxicity characteristics or listing additional wastes by name. 2/ These varying definitions have created large discrepancies in the reported amount of hazardous waste.

CHARACTERIZING HAZARDOUS WASTE GENERATION AND MANAGEMENT--THE CBO DATA SYSTEM

To reconcile the various definitions discussed above and to arrive at a picture of the current state of hazardous waste generation, treatment, and disposal, CBO developed a comprehensive computer-based data system. This system was also employed to assess alternatives to current regulatory policy. The data system consists essentially of three major elements:

- A hazardous waste generation model that predicts, on the basis of industrial output, waste flows by type of waste, type of industry, and state;
- A treatment and disposal network that directs the predicted wastes to treatment and disposal options (to mimic current management practice) or into required treatment technologies (to reflect possible regulatory strategies); and

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2. See, for example, Linda Greer, "Definition of Hazardous Waste," *Hazardous Waste*, vol. 1, no. 3 (November, 1984).

- Cost models that estimate relevant capital and operating costs of treatment and disposal technologies as a function of facility size.

A fourth element--cost breakpoints for off-site management--provides estimates of the quantities of waste that were treated and disposed of either at the site of generation or transported to off-site, commercial waste handling facilities. Figure 1 presents a diagram of this system. [3]

Waste Generation Model

The waste generation model tracks 24 types of waste produced by the 70 largest waste-generating industries, as identified by state generator reports and the EPA's most recent survey. These 70 industries generated about 95 percent of all wastes in 1981. [4] The driving assumption of the model is that specific industries generate characteristic sets of wastes at measurable rates, and that the overall quantity of waste produced is a function of industrial output (as measured by production employment), process technology, and production efficiency.

Current waste generation rates--by type of waste and by industry--are estimated from plant-level waste generation and employment data obtained from the EPA, state agencies, and the Dun and Bradstreet Company. Predictions at the national level are considered reliable within calculated ranges (or confidence intervals). Regional differences in industrial characteristics make waste generation estimates by state somewhat less sure.

Using the model to predict future waste generation patterns, as is done in Chapters III and IV, is difficult, however, because the model contains countervailing biases. The model might underestimate waste generation in future years because of the use of production employees as a proxy for output by industry. Projections of employment growth by industry, obtained from the Bureau of Labor Statistics (BLS), were used because they were the only consistent set of industry-specific projections available. The use of

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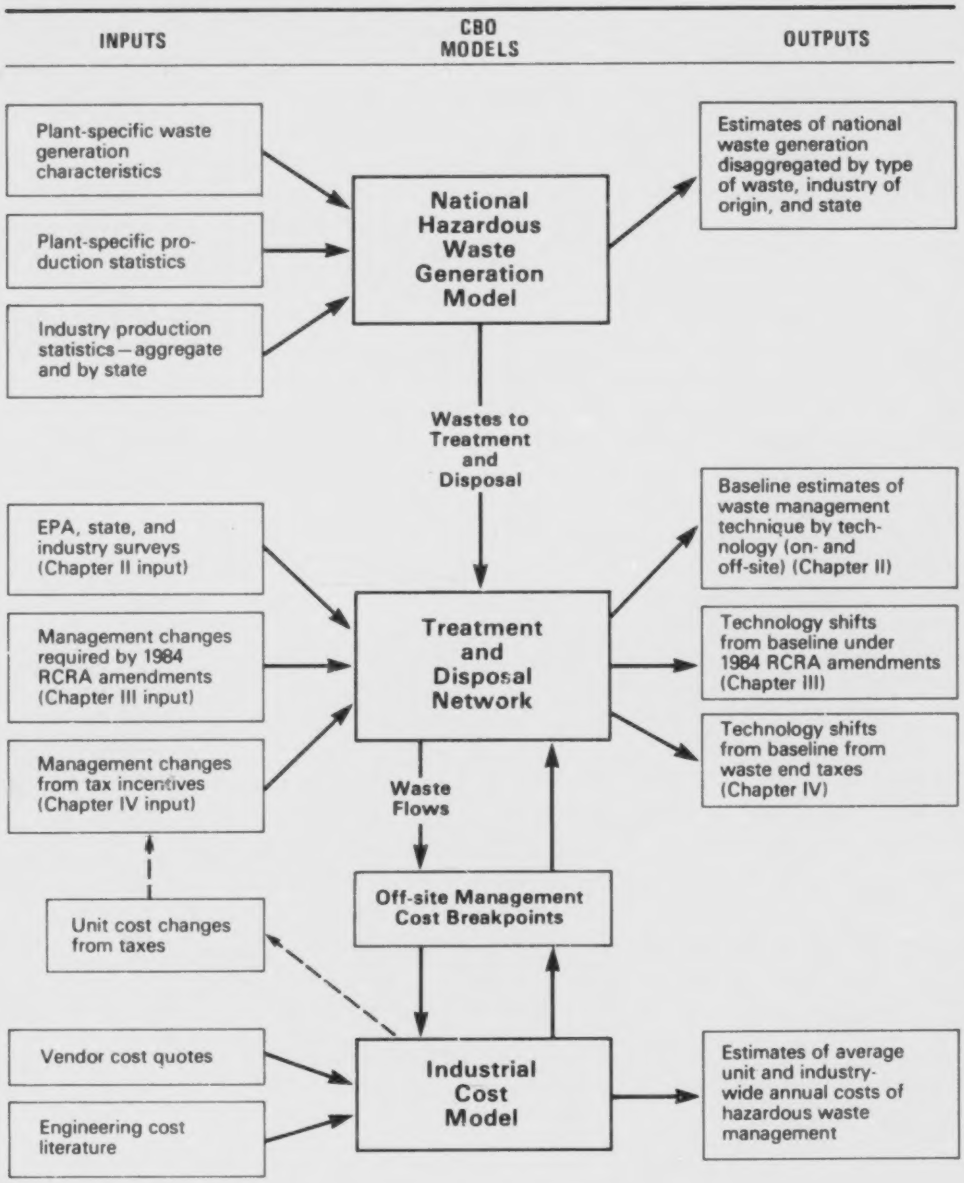
3. The CBO data system is described in detail in Congressional Budget Office, *Empirical Analysis of U.S. Hazardous Waste Generation, Management, and Regulatory Costs*, Staff Working Paper (unpublished, forthcoming). This paper is available on request from CBO.

4. See Environmental Protection Agency, *National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated Under RCRA in 1981* (1984). Industries in the CBO model are identified at the two- or four-digit level of the Standard Industrial Classification system (there are 450 four-digit industries). See Office of Management and Budget, *Standard Industrial Classification Manual* (1972).

Figure 1.

Diagram of CBO Data System


INPUTS
CBO MODELS
OUTPUTS
Plant-specific waste generation characteristics
Plant-specific production statistics
Industry production statistics—aggregate and by state
National Hazardous Waste Generation Model
Estimates of national waste generation disaggregated by type of waste, industry of origin, and state
Wastes to Treatment and Disposal
EPA, state, and industry surveys (Chapter II input)
Management changes required by 1984 RCRA amendments (Chapter III input)
Management changes from tax incentives (Chapter IV input)
Treatment and Disposal Network
Baseline estimates of waste management technique by technology (on- and off-site) (Chapter II)
Technology shifts from baseline under 1984 RCRA amendments (Chapter III)
Technology shifts from baseline from waste end taxes (Chapter IV)
Waste Flows
Off-site Management Cost Breakpoints
Unit cost changes from taxes
Vendor cost quotes
Engineering cost literature
Industrial Cost Model
Estimates of average unit and industry-wide annual costs of hazardous waste management

production employee statistics for projections, however, might underestimate output, since growth in labor productivity over time will lead to growing amounts of output (and, presumably, wastes) per employee. The BLS, for example, estimates that labor productivity in the chemicals and allied products industry--which will generate about 48 percent of the total amount of waste in 1990--will grow at a rate of 0.9 percent annually. Thus, using employment as a proxy for output could understate the amount of output and wastes produced by about 5 percent from a 1984 base, assuming no reductions in the waste generation rate from technological changes. The problem is complicated by the fact that the BLS projections foresee differing rates of productivity growth by industry, with some estimated to be negative. 5/

On the other hand, the model projections might overstate the amount of wastes produced by failing to account for turnover in the capital stock of those industries that generate waste. New industrial facilities probably would be more efficient, reflecting improvements in technology and plant management, and should produce less waste per worker or per unit of output. 6/ By assuming that the relationship between output and generated wastes is constant, the model fails to incorporate this type of improvement.

Because there is no way to know whether either of these effects would be greater than the other, the model contains some uncertainties. For this reason, waste estimates presented here are based on ranges that incorporate uncertainties about waste generation rates.

The model employs a broader definition of hazardous waste than that established by the EPA under RCRA, but one less comprehensive than the broadest state definition. It includes the following wastes not currently covered by the EPA: waste oils, PCBs, industrial scrubber sludges, air pollution control dusts, and certain liquid hazardous waste streams. 7/ Because CBO's waste coverage is so broad, estimates of waste quantities should be relatively unaffected by any additions to the list of regulated wastes made

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5. See Bureau of Labor Statistics, *Handbook of Methods*, Bulletin 2134-1 (1982).

6. See, for example, *Future Hazardous Waste Generation in California*, Report to the California Hazardous Waste Management Council (October 1982).

7. Waste oils may be brought under EPA regulation by the end of 1985 (see the amended RCRA, Section 241). The control of industrial sludges and dusts is now under study by the EPA (see RCRA, Section 8002); the relative hazard of such wastes varies greatly by industry type and individual facility operations. PCBs are currently regulated as toxic substances under the Toxic Substances Control Act (TSCA).

by EPA under the 1984 RCRA amendments.[8] The model does not include hazardous wastes generated by U.S. government facilities (the Department of Defense produces about 100,000 metric tons annually) or wastes derived from Superfund cleanup activities that could require disposal or treatment during the year. Because of these assumptions, direct comparisons of CBO's waste generation and management estimates with other studies should be exercised with caution.

Table 1 presents the types of hazardous waste considered in the analysis. The waste classification system groups all waste types into 24 categories on the basis of major constituent and physical state (liquid, sludge, or solid). A distinct set of waste disposal and treatment technologies is applicable to all wastes within any single waste category, regardless of its industry of origin. The potential hazards of each waste category vary significantly. Equal quantities of different waste types can pose greatly different health risks. Actual health risks will also vary according to disposal methods and population exposure levels.

The model does not distinguish among these wastes on the basis of hazard, however, except for the "high-priority" wastes--such as dioxins, cyanide and metal liquids, PCBs and halogenated organics--that the Congress identified in the 1984 RCRA amendments. These wastes and associated disposal methods are given special treatment in the waste tax systems examined in Chapter IV.

Treatment and Disposal Network

The CBO treatment and disposal network directs hazardous waste from the point of generation to a method of treatment or disposal. The industrial waste flows identified by the EPA and the states under various waste coding systems are translated into the set of 24 waste types identified in Table 1. This conversion groups all hazardous wastes into distinct treatment categories, based on the treatment and disposal requirements of the key waste constituents within each category. The model then directs these wastes to their appropriate treatment or disposal technology, according to different

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[8] An important exception could be additional wastes identified by an expanded toxicity characteristic now under consideration by EPA. If adopted, from 60,000 to 20,000,000 metric tons of waste could fall under RCRA requirements. See *Regulatory Impact Analysis for Characteristic Approach to Regulation of 40 Organic Constituents* (prepared for the EPA Office of Solid Waste by Research Triangle Institute, September 1984 Draft). In some states, such as Washington, wastes of this type--such as chlorobenzenes and polycyclic aromatic hydrocarbons--might increase the regulated waste coverage by as much as 20 percent.

TABLE 1. A CBO WASTE CLASSIFICATION SYSTEM BASED ON MAJOR CONSTITUENT AND PHYSICAL STATE

Waste Type	Examples
Liquids	
Waste Oils	Spent crankcase oil, industrial lubricants
Halogenated Solvents	Spent trichloroethylene, chloroform, carbon tetrachloride
Nonhalogenated Solvents	Spent acetone, methylethyl ketone
Other Organic Liquids	Aqueous organic solutions from cleaning or degreasing operations
Metal-Containing Liquids	Metal finishing solutions (acidic or alkaline)
Cyanide and Metal Liquids	Neutralized acid or basic washes with cyanide salts
Polychlorinated Biphenols (PCBs)	Transformer fluids
Nonmetallic Inorganic Liquids	Acidic or basic solutions without metals
Sludges	
Oily Sludge	Tank bottoms, oil/water separation sludge
Halogenated Organic Sludge	Halogenated still bottoms
Nonhalogenated Organic Sludge	Still bottoms without halogens
Metal-Containing Sludge	Electroplating or chrome pigments, wastewater treatment sludges
Cyanide and Metal Sludge	Metal heat treating sludges
Nonmetallic Inorganic Sludge	Sulfur sludge, lime sludge
Dye and Paint Sludge	Heavy metal and solvent sludges
Solids	
Contaminated Clay, Soil, Sand	Clay filters, spilled material
Metallic Dusts and Shavings	Primary metal dusts and metal machinery wastes, emission control dusts from steel and lead industries
Nonmetallic Inorganic Dusts	Precipitator or baghouse wastes
Halogenated Organic Solids	Polyvinyl
Nonhalogenated Organic Solids	Polyethylene, cyclic intermediates
Mixed	
Pesticides, Herbicides	Pesticides, dioxins, and other production wastes
Explosives	TNT, wastewater treatment sludges from explosives production
Miscellaneous Wastes	Lab waste chemicals, equipment, containers, unspecified wastes
Resins, Latex, Monomer	Phenols, epoxy, polyester

SOURCE: Congressional Budget Office.

waste management scenarios. The waste flow network was adjusted to mimic both industry's practices for 1983 (based on EPA and state data and industry surveys) and projected waste management changes from 1984 through 1990 resulting from the regulatory changes or tax incentives examined in Chapters III and IV, respectively.

Assignments of treatment and disposal options in the 1983 baseline are consistent with the assumption that industry will attempt to meet applicable pollution control regulations while minimizing costs. Hence, the 1983 baseline assumes full compliance with the RCRA and Clean Water Act regulations, using the least costly alternatives available under these regulations. Although each assignment of a treatment technology to a waste type is well documented in the engineering literature, their use across all waste generators is much less certain. Thus, for some waste types, the exact percentage treated by a particular method is generalized and not tailored to account for the variations in chemical composition, chemical characteristics, or percentage of solids that could result from different industrial processes. For other waste types, however, individual industry surveys allowed more specificity. (This process is described further in CBO, *Empirical Analysis*.)

Future network assignments for the 1984-1990 period (presented in Chapter III) are also based on full compliance with existing regulations, including all changes required by the 1984 RCRA amendments.

Industrial Cost Model

CBO also developed an industrial cost model to estimate unit costs of 32 prevalent methods for hazardous waste treatment and disposal. Costs for applicable treatments were derived from standard engineering and industry sources. For each treatment technology, capital and operating costs were assembled for several facility sizes. Unit costs were derived as a function of annual treatment levels. 9/ These costs were then matched to the baseline estimates of waste management volumes from the treatment and disposal network to estimate the hazardous waste management costs for major industry groups presented in this chapter.

Industrywide and average plant annual costs also are derived in Chapter III, following expected changes in waste management flows as a result of

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9. This flow-based approach also was used to estimate the shares of waste managed on- and off-site by calculating the waste quantity below which on-site management would be uneconomical compared with off-site commercial use of treatment technologies. (See CBO, *Empirical Analysis*, for details).

the 1984 RCRA amendments. The cost model also helped analyze the effects of waste taxes on waste management practices shown in Chapter IV. By changing the technology cost structure facing industry (variable tax rates can easily erode the cost advantage previously held by a disposal technology), waste taxes were found to cause shifts in the waste management network.

Cost estimates presented throughout the paper represent an upper bound for industrial compliance expenditures, because the model does not include the effects of investment tax credits and rapid depreciation of capital equipment. Potential savings from firms' ability to write off their noncapital costs immediately are also not captured by the cost model. In practice, most firms take advantage of these tax provisions.

Probably the greatest weakness in the unit cost estimations, however, results from the model's aggregation of all hazardous wastes into 24 generalized waste types. Variations in the character of individual waste streams, not captured by these categories, can greatly affect actual treatment costs. A prominent example of these effects involves the great variance in the energy content of wastes that are incinerated. Wastes with low energy content require costly supplemental fuel to burn properly. In addition, the recovery potential for metals and solvents from some waste streams is greater than from others. The model therefore uses the unit costs associated with the "average waste" contained in each of the 24 categories.

HAZARDOUS WASTE GENERATION

The CBO estimates that the 70 major waste-producing industries generated some 266 MMT of hazardous waste in 1983 (see Table 2). Taking into account the margin of error in the model, the estimate could range as high as 308 MMT or as low as 223 MMT. (This margin of error is based on a 95 percent statistical confidence interval.)

This estimate compares well with two other, less detailed, estimates of national hazardous waste generation. In one, the EPA estimated that RCRA-controlled waste produced in 1981 could range from 132 MMT to 395 MMT, with the most probable amount being 264 MMT. 10/ In the other, the Office of Technology Assessment estimated that some 255 MMT to 275 MMT of hazardous waste were generated in 1981, based on a survey of states conducted by the Association of State and Territorial Solid Waste

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10. See Environmental Protection Agency, *National Survey* (1984), p. 135.

TABLE 2. ESTIMATED NATIONAL GENERATION OF INDUSTRIAL HAZARDOUS WASTE IN 1983, RANKED BY WASTE QUANTITY (In thousands of metric tons)

Waste Type	Estimated Range Lower	Estimated Range Upper	Mean Quantity	Percent of Total
Nonmetallic Inorganic Liquids	68,102	96,420	82,261	31
Nonmetallic Inorganic Sludge	23,285	32,837	28,061	11
Nonmetallic Inorganic Dusts	19,455	22,784	21,120	8
Metal-Containing Liquids	14,125	25,394	19,760	7
Miscellaneous Wastes	14,438	16,393	15,415	6
Metal-Containing Sludge	13,246	15,748	14,497	6
Waste Oils	9,835	18,664	14,249	5
Nonhalogenated Solvents	11,325	12,935	12,130	5
Halogenated Organic Solids	9,321	10,246	9,784	4
Metallic Dusts and Shavings	6,729	8,738	7,733	3
Cyanide and Metal Liquids	4,247	10,520	7,383	3
Contaminated Clay, Soil, and Sand	5,092	5,830	5,461	2
Nonhalogenated Organic Solids	4,078	5,078	4,578	2
Dye and Paint Sludge	4,035	4,438	4,236	2
Resins, Latex, and Monomer	3,451	4,585	4,018	2
Oily Sludge	2,965	4,502	3,734	1
Halogenated Solvents	2,774	4,185	3,479	1
Other Organic Liquids	2,866	4,003	3,435	1
Nonhalogenated Organic Sludge	2,179	2,305	2,242	1
Explosives	508	933	720	a
Halogenated Organic Sludge	583	848	715	a
Cyanide and Metal Sludge	537	577	557	a
Pesticides, Herbicides	19	33	26	a
Polychlorinated Biphenols	1	1	1	a
Total	223,196	307,997	265,595	

SOURCE: Congressional Budget Office.

a. Less than one percent.

Management Officials. [11] A comparison of estimates, however, may not be appropriate because of each estimates' different definitions of hazardous waste and because of the downturn in industrial production--with an accompanying expected decrease in waste generation--that occurred between 1981 and 1983.

Types of Waste Generated

Table 2 shows that two types of waste--nonmetallic inorganic liquids and sludges--accounted for almost half of all wastes generated in 1983. [12] Inorganic liquids (nonmetallic inorganic liquids, metal-containing liquids, and cyanide and metal liquids) comprised about 41 percent of total generation. Seventeen percent of total hazardous waste generation was composed of inorganic sludges (semi-solid waste streams of nonmetallic inorganic, metal-containing, and cyanide and metal sludges).

The inorganic solids waste group--nonmetallic inorganic dusts and metallic dusts and shavings--accounted for about 11 percent of total waste generation. These wastes are mostly fly and bottom ash from the combustion of fossil fuels and substances captured in air emissions control devices used by primary metals industries. Finally, waste oils and oily sludges comprised about 7 percent, while organic sludges and solids other than oily sludges represented about 6 percent.

Waste Generating Industries

In 1983 almost half (48 percent or about 127 MMT) of all hazardous waste was generated by the chemical and allied products industries (see Table 3). The industrial organic segment of the chemical industry alone produced an estimated 47 MMT (17.5 percent), consisting primarily of organic and inorganic liquids. The industrial inorganic chemical industry generated an estimated 37 MMT (about 19 percent), chiefly consisting of inorganic liquids and sludges.

The primary metals industries contributed the second highest quantity of hazardous waste--about 48 MMT, or about 18 percent of the estimated national total. Almost half was in a solid form, either with or without metals. These wastes essentially were dusts captured by electrostatic precipitators and baghouses, dry lime from scrubbing operations, and solidified residues from primary metals foundries.

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[11] See Office of Technology Assessment, *Technologies and Management Strategies* (1983), p. 121.

[12] For simplicity, the discussion of results throughout the remainder of this chapter will focus on mean estimates provided by the CBO model.

The third largest generator of wastes, with an estimated total of 31 MMT, or about 12 percent of the national total, were the petroleum products industries--predominantly refining plants. While many of these wastes were classified as waste oil or oily sludge (41 percent), some 9 MMT consisted of spent halogenated and nonhalogenated solvents used in degreasing operations.

The fabricated metal products industries generated an estimated 25.4 MMT of hazardous residuals in 1983, accounting for about 10 percent of the

TABLE 3. ESTIMATED NATIONAL GENERATION OF INDUSTRIAL HAZARDOUS WASTES RANKED BY MAJOR INDUSTRY GROUP [a] (In thousands of metric tons)

Major Industry	Estimated Quantity in 1983	Percent of Total
Chemicals and Allied Products	127,245	47.9
Primary Metals	47,704	18.0
Petroleum and Coal Products	31,358	11.8
Fabricated Metal Products	25,364	9.6
Rubber and Plastic Products	14,600	5.5
Miscellaneous Manufacturing	5,614	2.1
Nonelectrical Machinery	4,859	1.8
Transportation Equipment	2,977	1.1
Motor Freight Transportation	2,160	0.8
Electrical and Electronic Machinery	1,929	0.7
Wood Preserving	1,739	0.7
Drum Reconditioners	45	b
Total	265,595	100.0

SOURCE: Congressional Budget Office.

a. See CBO, *Empirical Analysis*, Table 1 for the master list of specific industry types that are aggregated into the major industry groups presented in this table.

b. Less than one-tenth of one percent.

national total. These wastes consisted almost entirely of inorganic liquids and sludges with metals.

Waste Generation By State

The distribution of hazardous waste generation by state reflects each state's industrial activity (see Table 4). 13/ Texas ranked first among the states for waste generation with about 13 percent of the national total. A relatively high proportion of employment in highly waste-producing industries accounts for this high ranking. For example, Texas industries employ about 30 percent of all labor in the industrial organic chemicals industry, 11 percent in the industrial inorganic chemicals industry, and 30 percent in the petroleum refining industry.

Ohio ranked second in hazardous waste generation, with about 7.4 percent of the estimated national total. Ohio's industrial base is dominated by the chemicals, primary metals, and fabricated metal products industries. California, Illinois, Louisiana, New Jersey, Michigan, and Tennessee each accounted for about 5 percent of the national total. Indiana, New York, Alabama, Missouri, Washington, and West Virginia each generated between 2 percent and 4 percent. Alaska, Hawaii, Maine, Nevada, North Dakota, South Dakota, and Vermont had the lowest rates of hazardous waste generation in the country.

WASTE MANAGEMENT TECHNOLOGIES AND COSTS

The intent of the original 1976 RCRA was twofold: first, to promote the reuse or recycling of materials; and second, to protect public health and the environment from the risks of improper management of industrial hazardous wastes. Only limited anecdotal evidence exists to support achievement of the first goal. In fact, because the 1976 act permitted industries to use relatively inexpensive land disposal technologies, it provided few incentives to promote waste reuse.

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13. CBO's state generation estimates are provided for limited purposes of comparison; significant differences may exist between CBO's estimate and individual state surveys because of varying definitions of regulated hazardous waste. As noted in the previous section, the model's disaggregation of waste estimates to the state level yields results considered less reliable than those at the national level. The CBO model was successfully tested against two recent state agency waste surveys, however. In each case, the independent state value fell between the model's predicted range of values.

TABLE 4. ESTIMATED GENERATION OF INDUSTRIAL HAZARDOUS WASTE IN 1983, BY STATE (In thousands of metric tons)

State	Quantity	Percent of National Generation	State	Quantity	Percent of National Generation
Alabama	6,547	2.5	Montana	662	0.2
Alaska	52	a	Nebraska	739	0.3
Arizona	642	0.2	Nevada	379	0.1
Arkansas	3,729	1.4	New Hampshire	431	0.2
California	17,284	6.5	New Jersey	12,948	4.9
Colorado	1,902	0.7	New Mexico	619	0.2
Connecticut	4,238	1.6	New York	9,876	3.7
Delaware	894	0.3	North Carolina	3,954	1.5
Florida	2,981	1.1	North Dakota	269	0.1
Georgia	3,338	1.3	Ohio	19,692	7.4
Hawaii	202	0.1	Oklahoma	2,673	1.0
Idaho	1,160	0.4	Oregon	969	0.4
Illinois	14,810	5.6	Pennsylvania	18,260	6.9
Indiana	10,189	3.8	Rhode Island	1,745	0.7
Iowa	1,774	0.7	South Carolina	3,669	1.4
Kansas	2,564	1.0	South Dakota	159	0.1
Kentucky	4,647	1.7	Tennessee	12,159	4.6
Louisiana	13,801	5.2	Texas	34,866	13.1
Maine	337	0.1	Utah	1,139	0.4
Maryland	2,989	1.1	Virginia	4,038	1.5
Massachusetts	4,536	1.7	Vermont	226	0.1
Michigan	12,399	4.7	Washington	5,523	2.1
Minnesota	2,212	0.8	Wisconsin	3,297	1.2
Missouri	6,046	2.3	West Virginia	5,642	2.1
Mississippi	1,816	0.7	Wyoming	572	0.2
			Total	265,595	100.0

SOURCE: Congressional Budget Office projections for 1983 based on 1981 state employment shares found in Bureau of Census, U.S. Department of Commerce, *County Business Patterns 1981* (1981).

a. Less than one-tenth of one percent.

Moreover, relatively little progress has been made toward achieving the second goal. Industry has continued to rely on land disposal in facilities that are likely to contaminate groundwater and surface waters eventually. The CBO estimates that in 1983 roughly 180 million tons, or 68 percent of all hazardous waste, were deposited in or on the land, encompassing methods such as deepwell injection, surface impoundment, and landfilling (see Table 5). For this reason, the 1984 RCRA amendments sought to limit or ban the land disposal of certain wastes in favor of presumably safer alternatives. Until the new limitations take effect, however, it appears that land disposal will remain the prevalent mode. Thus, waste management practices, perhaps through 1986 or beyond, will remain similar to those used in 1983.

Waste Management Technologies

Injection Wells. Injecting hazardous liquid wastes into deep underground wells or salt caverns was the most prominent method of land disposal in 1983, receiving an estimated 67 MMT of wastes. [14] Deep-well injection typically involves drilling a disposal passage into salt caverns or aquifers and pumping wastes through wells into these geologic formations. This technique is popular because more than adequate capacity is available, the cost of well disposal is relatively low, and fewer problems are associated with establishing an on-site injection well than other facilities. The siting of hazardous waste landfills, for example, can face stronger public opposition. Some underground injection methods pose substantial risks to public health, however. For this reason, the 1984 RCRA amendments required that, within six months of enactment, the unsafe practice of injecting wastes directly into underground drinking water sources be terminated in all 50 states. (This practice was formerly allowed in states that lacked approved regulatory programs under the Safe Drinking Water Act.)

Sewer and Direct Discharge. The CBO also estimates that about 59 MMT of liquid wastes were discharged to sewers or surface waters in 1983. This estimate does not include all potentially hazardous materials discharged under Clean Water Act regulations; both EPA and the Chemical Manufac-

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[14] Differences between CBO's waste management estimates and those contained in EPA's *National Survey* result in large part from the different definitions of hazardous waste used for each estimate. See CBO, *Empirical Analysis* for detailed comparison of the two studies' estimates.

TABLE 5. WASTE QUANTITIES MANAGED IN 1983, RANKED BY MAJOR TECHNOLOGY (In millions of metric tons)

Technology	Description	Quantity Managed	Percent of Total
Injection Well	Injection of liquid wastes into wells or salt caverns	66.8	25
Sewer and Direct Discharge	Discharge of treated and untreated liquids to municipal sewage treatment plants, rivers, and streams	58.9	22
Surface Impoundment	Placement of liquid wastes or sludges in pits, ponds, or lagoons	49.5	19
Hazardous Waste Landfill	Placement of liquid or solid wastes into lined disposal cells that are covered by soils	34.2	13
Sanitary Landfill	Placement of wastes in unlined dump sites, which normally receive only inert, nonhazardous materials	26.7	10
Distillation	Recovery of solvent liquids from other waste contaminants through fractional distillation	10.9	4
Industrial Boilers	Burning of wastes in industrial and commercial boilers as a fuel supplement	9.5	4
Oxidation	Chemical treatment of reactive wastes	3.0	1
Land Treatment	Biodegradation of liquid wastes or sludges in soils	2.9	1
Incineration	Burning of wastes in advanced technology incinerators meeting stringent environment standards	2.7	1
Ion Exchange	Recovery of metals in solution through membrane separative techniques	0.5	a

SOURCE: Congressional Budget Office.

a. Less than 1 percent.

turers Association believe the total figure to be substantially higher. [15] Because municipal pretreatment systems and effluent standards for direct discharge, required under the Clean Water Act, are not yet in place everywhere or for all industries, however, substantial quantities of untreated wastes (such as cyanide and metal solutions) are released into the sewer systems of some municipalities or directly to waterways. For example, the General Accounting Office (GAO) found that about 25 percent of small hazardous waste generators disposed of their wastes in this manner. [16] But, most of these 59 MMT represents liquid residuals from other treatment processes, and if adequately treated, these residuals pose little or no environmental threat.

Surface Impoundments. Surface impoundments, or holding ponds, the second most prevalent land disposal method, received an estimated 50 MMT of hazardous waste in 1983. This technique poses risks because many impoundments have no liners to prevent waste seepage into surface water or groundwater, despite existing regulations requiring such protection. A five-year EPA study concluded that over 70 percent of the estimated 80,000 surface impoundments accepting hazardous wastes were unlined. In all, 90 percent of these impoundments are believed to pose at least a potential threat of groundwater contamination. [17]

Hazardous Waste Landfills. These landfills, which must be *lined*, received an estimated 34 MMT, or 13 percent, of all wastes disposed of in 1983. EPA regulations acknowledge the inadequacy of this type of technology, and most experts agree that landfills eventually will leak their contents into surrounding groundwater, despite their linings. Yet, less than 5 percent of wastes placed in landfills are chemically or physically stabilized to reduce the chances of waste migration into groundwater. [18]

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15. The EPA estimated that 70 MMT of toxic metals solutions and aqueous organic streams are discharged annually. See EPA, *Addendum to Report Entitled Assessment of the Impacts of Industrial Discharges on Publicly-Owned Treatment Works*, (prepared by JRB Associates, February 1983). The Chemical Manufacturers Association's discharge estimate for 1981 and 1982 was even higher.

16. General Accounting Office, *Information on Disposal Practices of Generators of Small Quantities of Hazardous Wastes* (September 28, 1983).

17. See Environmental Protection Agency, *Surface Impoundment Assessment National Report* (December 1983).

18. This technology is proven, but relatively expensive. See, for example, Robert B. Pojasek, ed., *Toxic and Hazardous Waste Disposal* (Ann Arbor Science, 1979).

Sanitary Landfills. According to CBO estimates, about 27 MMT of potentially hazardous wastes entered sanitary landfills in 1983. (Sanitary landfills, as distinct from hazardous waste landfills, are *unlined* dump sites which are designed to receive only nonhazardous wastes.) The majority of these inorganic wastes--about 23 MMT--was composed of metallic and nonmetallic dusts, generated chiefly by the primary metals, steel, and iron foundry industries. Most were disposed of adjacent to generating plants in compliance with existing federal and state regulations. These wastes are not currently regulated under RCRA, pending the completion of Congressionally mandated studies of their potential toxicity. Because some of these waste types have demonstrated significant hazards when deposited in unlined landfills, however, the use of this disposal method might threaten groundwater. Another four MMT of wastes estimated to be entering municipal and private sanitary landfills clearly pose contamination risks, because they are already identified as hazardous under RCRA. Under current EPA regulations, such wastes could legally enter off-site sanitary landfills if produced by "small generators" of less than 1,000 kilograms (kg)--about one ton per month. The 1984 RCRA amendments lowered this regulatory exemption to include only firms that generate less than 100 kg per month. But generators of between 100 kg to 1,000 kg per month can continue to use sanitary landfills until March 31, 1986.

On-Site Versus Off-Site Management

Most hazardous wastes are treated and disposed on-site, that is, within plant grounds (see Table 6). The CBO estimates that about 255 MMT, or 96 percent of all wastes, are managed on-site, while only about 10 MMT, or 4 percent, are transported to commercial off-site facilities. On-site management generally takes place at large industrial plants, which generate volumes of waste large enough to make investment in close-by treatment and disposal facilities attractive (or transportation of wastes off-site for treatment impractical). Conversely, small plant waste flows do not warrant the capital expenses of on-site management. For these flows, it is more cost-effective to send wastes to larger commercial waste management facilities with greater economies of scale. Although it is arguable that proper waste management is more difficult to enforce on-site than it is at commercial off-site facilities, the former offers the advantage of reducing contamination and public health risks from transportation accidents and spills.

Current Costs to Industry for Waste Disposal

In 1983 the 70 industries covered by CBO's model spent an estimated $4.2 billion to $5.8 billion on hazardous waste management (see Table 7).

This range reflects different assumptions on compliance. The higher estimate assumes full compliance with Clean Water Act regulations and land disposal regulations under RCRA, while the lower estimate reflects partial compliance. Under the partial compliance cost estimate, lower unit costs are assumed for land disposal technologies not yet in full compliance with current regulations. 19/ Tax considerations are omitted for both cost esti-

TABLE 6. ON-SITE AND OFF-SITE WASTE FLOWS MANAGED BY MAJOR INDUSTRY GROUPS IN 1983
(In millions of metric tons)

	Flow		Percent of Total[a]	
Major Industry	On-Site	Off-Site	On-Site	Off-Site
Chemicals and Allied Products	125.9	1.2	99	1
Primary Metals	47.3	0.3	98	2
Petroleum and Coal Products	31.0	0.3	99	1
Fabricated Metal Products	24.8	0.6	98	2
Rubber and Plastic Products	11.5	3.0	80	20
Miscellaneous Manufacturing	4.5	0.9	83	17
Nonelectrical Machinery	4.3	0.6	88	12
Transportation Equipment	2.5	0.5	83	17
Motor Freight Transportation	0.2	2.0	11	89
Electrical and Electronic Machinery	1.7	0.2	90	10
Wood Preserving	1.7	b	100	0
Drum Reconditioners	b	b	11	89
Total	255.0	10.3	96[c]	4[c]

SOURCE: Congressional Budget Office.

a. Percents were calculated before rounding.

b. Less than 0.1 million metric tons.

c. Weighted average.

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19. The Code of Federal Regulations (Volume 40, Part 264) details the engineering standards for landfills and other modes of land disposal. Many land disposal facilities not meeting final regulatory standards have been operating under interim approval from EPA. These facilities will provide lower operating costs for industry until they are closed or upgraded.

mates. Generally, investment tax credits and rapid depreciation deductions are taken by firms, lowering their net costs.

Of the higher total, about $4.6 billion, or 80 percent of total expenditures, are attributable to on-site management. Another $1.2 billion, or 20 percent, was spent on off-site commercial waste management services. The chemicals and allied products industries spent the largest sum--$1.5 billion. The primary metals industries spent the second largest amount--about $1.2 billion.

Comparison of Expenditures to Sales and Value Added. One way to compare spending across industries is to examine the percent of sales revenue necessary to cover hazardous waste management costs (see Table 8). In 1983 the wood preserving industry devoted the greatest percentage (4 per-

TABLE 7. ANNUAL EXPENDITURES BY MAJOR INDUSTRY GROUPS FOR HAZARDOUS WASTE MANAGEMENT UNDER 1983 BASELINE POLICY
(In millions of 1983 dollars)[a]

Major Industry	Partial Compliance Estimate[b]	Full Compliance Estimate
Chemicals and Allied Products	894	1,544
Primary Metals	1,110	1,243
Fabricated Metal Products	750	899
Rubber and Plastic Products	549	798
Miscellaneous Manufacturing	130	267
Nonelectrical Machinery	207	254
Motor Freight Transportation	208	229
Transportation Equipment	124	191
Electrical and Electronic Machinery	109	156
Petroleum and Coal Products	70	136
Wood Preserving	46	56
Drum Reconditioners	5	6
Total[c]	4,202	5,779

SOURCE: Congressional Budget Office.

a. The 1983 baseline is described on p. 16.

b. Assumes lower unit costs for injection wells, landfills, and surface impoundments only.

c. Columns may not add to totals because of rounding.

TABLE 8. COMPARISON OF EXPENDITURES BY MAJOR INDUSTRY GROUPS FOR HAZARDOUS WASTE MANAGEMENT WITH SALES AND VALUE ADDED IN 1983
(In millions of 1983 dollars and percents)

Major Industry	Expenditures	Sales	Percent of Sales	Value Added	Percent of Value Added
Wood Preserving	56	1,350	4.1	432	13.0
Fabricated Metal Products	899	38,640	2.3	19,282	4.7
Chemicals and Allied Products	1,544	84,507	1.8	48,058	3.2
Rubber and Plastic Products	798	56,691	1.4	28,270	2.8
Primary Metals	1,243	123,122	1.0	44,770	2.8
Miscellaneous Manufacturing	267	29,701	0.9	15,384	1.7
Nonelectrical Machinery	254	83,839	0.3	27,563	0.5
Electrical and Electronic Machinery	156	46,967	0.3	46,507	0.5
Petroleum and Coal Products	136	175,242	0.1	29,327	0.5
Transportation Equipment	191	201,946	0.1	68,904	0.3
Motor Freight Transportation	299	a	a	b	b
Drum Reconditioners	6	a	a	b	b
Weighted Average			1.3		4.3

SOURCE: Congressional Budget Office.

a. Sales data not available.

b. Value added data not available.

cent) of sales to hazardous waste management. The transportation equipment and petroleum products industries devoted the smallest percentage of sales to hazardous waste management (less than 0.1 percent). The cost-weighted average across all industries was 1.3 percent.

A second way to view expenditures across industries is to compare hazardous waste management costs with industry value added (see Table 8). [20] Value added--the value of the manufactured goods less the cost of raw materials and intermediate goods--is a measure of business activity within and across industries. Omitting the effects of taxes--which can lower profits, but also lower compliance costs--profit is generally 5 percent to 20 percent of value added among these industries. Industry compliance costs, therefore, appear high enough in some cases to erode part or all of an individual firm's profits if compliance costs cannot be passed on to its customers. In the long run, plants in that industry might be forced to close if prices cannot be increased to compensate. Higher prices, in turn, could reduce demand for the domestically produced product, relative to overseas suppliers that might not operate under such stringent regulations.

According to this second measure, the average industry expenditure in 1983 was 4.3 percent of value added. Great variation exists among industry groups, however. For example, the wood preserving industry paid about 13 percent of value added for hazardous waste management, while the transportation equipment industry spent only 0.3 percent. While hazardous waste management cost wood preservers only a small net sum, it represented a very high percentage of value added. Conversely, the primary metals industries spent a relatively large net sum for hazardous waste management; but because their products have a much higher value, expenditures as a percent of value added appear quite low.

MANAGEMENT OF UNCONTROLLED WASTE SITES UNDER SUPERFUND

As mentioned previously, RCRA and its amendments are designed to ensure proper disposal of hazardous wastes. RCRA's regulations, however, do not cover all dumpsites once used by industry but abandoned before the act took effect in 1976. [21] Many such sites are currently contaminating ground-

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20. Because Table 8 presents expenditure and sales data by major industry group, this aggregated measurement may mask greater individual industry variation within each major group.

21. Because of the 1984 RCRA amendments (see new Section 3004(t)), corrective action is required for hazardous releases by any facility now seeking a permit under the act, even if the waste was actually placed in the facility before 1976.

water and surface waters, posing potential hazards to public health. The identification and cleanup of such sites are governed by and financed with the Superfund, a federal trust fund dedicated to such purposes. The fund is capitalized with a special tax on chemical and petroleum feedstocks, federal appropriations, penalties collected from firms found responsible for contamination, and interest earned on the fund balance. The fund will be nearly exhausted by the end of 1985, however, with only a fraction of priority sites cleaned up and projections of future fund needs of $10 billion to $100 billion.

Though passed in 1980, the Superfund program did not become fully operational until 1982. Progress in identifying, and therefore cleaning up, abandoned hazardous waste sites has been slow. Through fiscal year 1984, the EPA had completed 10,700 preliminary assessments for the roughly 19,000 potential hazardous waste sites now on the agency's inventory. The EPA hopes to complete preliminary assessments for nearly all the 19,000 sites by the end of fiscal year 1986 and to conduct full site inspections for half of these by the end of 1987.

On the basis of these inspections, EPA ranks the potential dangers of each site and then designates those most urgently in need of cleanup by listing them on the National Priorities List (NPL). Only designated NPL sites, which now number about 800, are eligible for long-term cleanup activity under Superfund authority. Cleanups of any site not on the NPL must be funded by state, local, or private money. The EPA has begun remedial action investigations for 290 sites and has initiated cleanups at 29 of the listed sites. Another 244 sites have been proposed for listing. Six sites have been fully restored and removed from the list.

Superfund money also is used to facilitate emergency cleanups of hazardous substance spills. In fiscal year 1984, the EPA and other federal agencies responded to over 400 such incidents. These shorter-term stabilization measures can be undertaken at any site, not just those listed on the National Priorities List.

Despite these activities, concerns have been raised about the effectiveness of Superfund. [22] Some restoration efforts have consisted merely of transferring wastes from the contaminated area to RCRA-approved landfills, which themselves could be leaking. Not only does such a practice perpetuate the Superfund cleanup process, but it also strains existing landfill capacity as Superfund cleanup wastes compete with newly generated wastes for disposal space.

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22. See Office of Technology Assessment, *Superfund Strategy* (March 1985).

The Cost of Superfund to Industry

Revenues to finance Superfund cleanups are derived primarily from three sources: excise taxes on feedstocks used by the petroleum refining and chemical manufacturing industries; appropriations from the general fund of the U.S. Treasury; and penalties, repayments, and interest earned on the fund balance. The bulk of revenues comes from the petrochemical taxes, which have provided about $250 million annually to the fund (out of an average annual total from all sources of about $350 million) over the fiscal year 1983-1985 period. The logic of the tax is that placement of a fee on basic petrochemical "building blocks" that are associated with waste generation distributes the costs of cleanup throughout the chain of production. Although rates vary, the average tax ranges from 1 percent to 3 percent of the products' sale prices. Total feedstock taxes paid annually by petroleum and chemical manufacturers is on the order of 0.1 percent of sales, compared with their expenditures for hazardous waste management under RCRA, which average about 1 percent of sales. Though some 600 firms pay Superfund taxes, 10 major chemicals and petroleum companies have paid nearly 50 percent of the annual total. 23/ These companies may recover some or all of these tax costs through product price increases.

Industries also can be subject to repayment expenses for the state and federal costs of Superfund cleanups. Precise amounts are subject to litigation. For example, the federal government is currently trying to recover $30 million to $40 million from the Hooker Chemical Company for its part in the Love Canal contamination. State claims against Hooker could total as high as $500 million.

GOVERNMENT COSTS

The federal government incurs costs both to manage its own wastes and to administer the federal RCRA and Superfund. U.S. government hazardous waste generation represents less than 1 percent of total annual waste generation. The primary federal waste generators, the Departments of Defense and Energy, spend about $420 million annually to manage their wastes in compliance with regulations and to cleanup problem waste sites.

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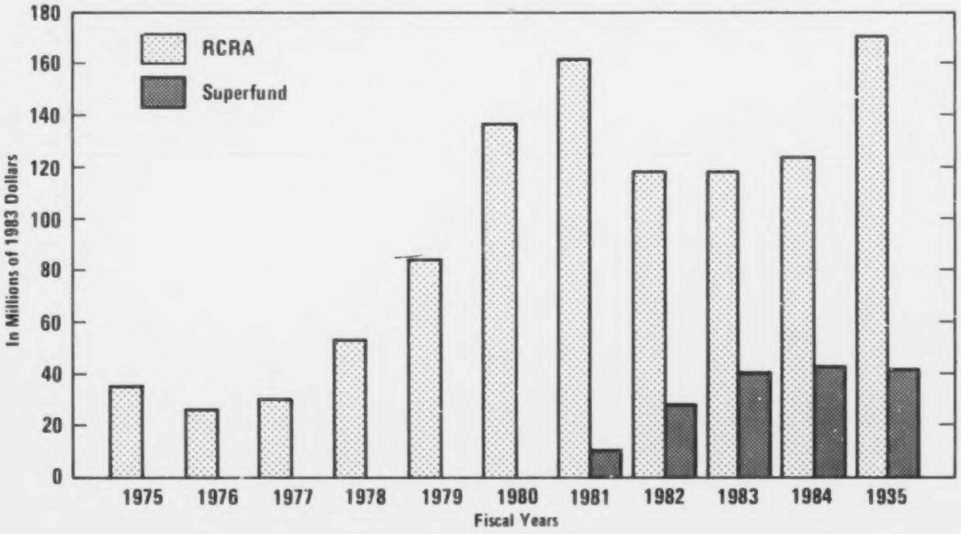
23. See Joint Committee on Taxation, ***Background and Issues Relating to the Reauthorization and Financing of Superfund***, Staff Report (April 24, 1985).

The federal cost of RCRA and Superfund has grown significantly over the last decade (see Figure 2). RCRA is now the third largest EPA program, with a fiscal year 1985 operating budget of $175 million. By 1986 RCRA could cost $239 million to administer. Superfund will cost the federal government about $44 million in fiscal year 1985. This contribution is less than 15 percent of annual Superfund revenues. Because average site cleanup costs have been estimated at $5 million to $10 million per site, only about 35 sites could be restored annually with the current level of feedstock taxes and federal appropriations. Recent proposals for federal contributions to the Superfund range from no direct appropriations after 1985 (the Administration's proposal) to a tenfold increase in the current level of federal appropriations (H.R. 5640, 98th Congress).

State spending is at least $82 million annually for both site cleanup and waste management activities. States must provide 10 percent of funds for any cleanup of Superfund sites within their borders, and often undertake independent cleanups for sites not yet federally designated. These activities cost states at least $70 million a year. States also must provide matching funds (25 percent of $47 million in 1985) for the federal grants they receive to operate EPA-approved RCRA waste management programs, with many states spending more than the required match.

Figure 2.

Federal Funding for Hazardous Waste Programs, 1975-1985



CHAPTER III

RECENT CHANGES TO THE HAZARDOUS WASTE MANAGEMENT SYSTEM--THE 1984 RCRA AMENDMENTS

Seven years after the initial passage of the Resource Conservation and Recovery Act (RCRA), the 98th Congress recognized that the act needed certain changes. The exemptions covering firms that produced only a small quantity of hazardous waste permitted a significant amount of waste to fall outside the regulatory network. Land disposal techniques allowed under the original law were found to be unsafe in many cases, offering little protection over the long term. Finally, some activities--notably underground storage of gasoline and other petroleum and chemical products--remained unregulated and threatened public health and the environment. To rectify these and other problems, the Congress enacted the Hazardous and Solid Waste Amendments of 1984 (Public Law 98-616).

This chapter describes the key provisions of the 1984 RCRA amendments and provides estimates of their effects on future waste management practices and costs. The purpose of these changes was to bring more hazardous waste under regulation and to close disposal pathways potentially harmful to public health. As a result of these changes, CBO estimates that by 1990--the earliest date the act's full effects should be felt--industry's compliance costs could double from 1983 levels. But, if industry achieved its maximum potential for reduction of waste generation, it would experience only half that increase. Lowering the production of all wastes would also support RCRA's stated goal to reduce the generation of hazardous waste as expeditiously as possible in order to enhance public health protection.

AMENDMENT CHANGES

The 1984 amendments contain three major categories of changes:

- o Expand the coverage of regulated waste, especially by lowering the regulatory exemption for small generators from 1,000 kilograms a month to 100 kilograms a month and by bringing more waste under regulation.
- o Change waste management practices, particularly by limiting or banning the use of land disposal of certain kinds of wastes.

- Bring under regulation some activities not previously controlled, such as underground storage tanks for petrochemicals and other chemicals.

The mandated changes are listed in Table 9.

TABLE 9. NEW EPA ACTIVITIES MANDATED BY 1984 RCRA AMENDMENTS[a]

Activity	Statutory Deadline
Expand Regulated Waste Coverage	
Small quantity generator study	4 months
Small quantity generator regulations	17 months
New listings of hazardous substances	6 months
New toxicity testing procedures	28 months
New characteristics of hazardous wastes based on organic toxicity	24 months
Change Waste Management Practices	
Ban on land disposal of bulk liquids in landfills	6 months
Ban on land disposal of high priority hazardous wastes	32 months
Ban on land disposal of solvents and dioxins	24 months
Minimum technological requirements for land disposal facilities	Immediate
Potential bans for first one-third of EPA's listed wastes	45 months
Potential bans for second one-third of EPA's listed wastes	55 months
Potential bans for third one-third of EPA's listed wastes	66 months
Ban on injecting wastes above or into drinking water aquifer	6 months
Standards for acceptable treatment technologies to diminish toxicity or risk of exposure	Concurrent with prohibitions
Regulate Additional Activities	
Interim construction standards for underground storage tanks	4 months
Performance regulations for existing and new undergound storage tanks	30 months
Salt dome storage performance standards	No limit

(Continued)

While the basic purpose of the new provisions was to eliminate loopholes found in the original law, another important intent was to eliminate the economic incentives that were promoting land disposal and other potentially unsafe practices, such as the blending of wastes with fuel oil for resale as residential heating fuel. By making unsafe technologies more expensive or unavailable, the Congress sought to encourage the development

TABLE 9. Continued

Activity	Statutory Deadline
Regulate Additional Activities (Continued)	
Regulations to minimize land disposal of hazardous liquids	16 months
Regulations for deep well injection of high priority wastes, dioxins, and solvents	45 months
Standards for monitoring and control of air emissions from treatment, storage, or disposal (TSD) facilities	30 months
Standards for leak detection systems for land facilities	30 months
Standards for areas of vulnerable hydrology precluding	18 months
siting of TSD facilities	18 months
Regulations on blending and burning hazardous wastes	24 months
Regulations on recordkeeping for blending and burning	15 months
Regulations on transporting fuels with hazardous wastes	24 months
Final permits for all TSD facilities	48 months
Final incinerator permits	60 months
Standards on generation and transportation of used oil for recycle	24 months
Regulations on exporting hazardous wastes from the United States	12 months
Ruling on the hazardousness of discharges from publicly owned sewage treatment works	18 months

SOURCE: Congressional Budget Office, based on the 1984 RCRA amendments.

a. Does not include several studies and inventories that the EPA must also perform within 36 months of enactment and several notification and certification activities required of private industry.

and use of more advanced techniques. [1] Moreover, by indirectly raising the costs of disposing of hazardous waste, the law attempted to encourage producers to lower the amount of waste they generated.

Expand Regulated Waste Coverage

The original RCRA regulations excluded large quantities and classes of hazardous waste from federal control, wastes which some states now regulate. [2] Chiefly excluded were small generator waste (an estimated 4 million metric tons per year) and wastes burned in boilers or blended for resale (10 MMT to 20 MMT). [3] To remedy this situation, the 1984 amendments direct the EPA to begin regulating a greater number of waste producers (the so-called small generators) and to expand the agency's definition of hazardous waste.

Under the original act, the EPA did not require generators of fewer than 1,000 kg a month of hazardous waste to dispose of their wastes in RCRA-approved facilities. Instead, these wastes were deposited in sanitary landfills or sewers connected to municipal sewage treatment plants. The 1984 amendments lowered the regulatory threshold for small generators to fewer than 100 kg per month, and required them to dispose of their wastes in RCRA-approved facilities or in sanitary landfills, pending EPA study of the need for further regulations. Concurrently, the act directed the EPA to upgrade the standards for sanitary landfill design as necessary to protect public health. The EPA must, therefore, decide whether to require sanitary landfills to comply fully with current hazardous waste landfill standards or to impose less stringent requirements, such as groundwater monitoring

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1. The various exemptions under the 1976 RCRA that limited the coverage of regulated waste also reduced the capacity utilization in the commercial hazardous waste treatment industry. For example, the Hazardous Waste Treatment Council, an association of alternative waste management companies, reported 30 percent to 50 percent unused capacity among member firms in 1982. The Environmental Protection Agency's 1984 waste survey confirmed this report.

2. Although originally excluded from RCRA regulation, these waste streams are included in the CBO waste generation model.

3. See *Solid Waste Disposal Act Amendments of 1983*, Report of the Senate Committee on Environment and Public Works to accompany S. 757, 98:1, pp. 3-4 (October 28, 1983). More recently, EPA has estimated that small quantity generators might produce only about 940,000 metric tons of hazardous waste per year, and that the amount of hazardous wastes and used oils burned in boilers each year ranges from 3.4 MMT to 5.4 MMT. See Abt Associates, *National Small Quantity Hazardous Waste Generator Survey*, (prepared for the EPA, February 1985); and Federal Register, vol. 50, no. 8 (January 11, 1985), p. 1684.

alone. Within 36 months, states must develop permit systems to ensure that these facilities meet the upgraded rules.

The 1976 act instructed the EPA to include substances for regulation based on their toxicity, persistence in the food chain, and degradability in nature. But the EPA abandoned tests for toxicity and bioaccumulation in December 1978, citing technical difficulties. 4/ Many wastes that contained potentially harmful levels of toxic organic constituents (but that were not identified by EPA's former regulatory scheme) therefore went unregulated. The 1984 amendments reinstructed the EPA to develop new criteria within two years for identifying hazardous wastes, such as halogenated solvents, pesticides, and vinyl chloride, on the basis of toxic organic, carcinogenic, or mutagenic constituents. The 1984 amendments also revised the procedure by which industries can receive regulatory exemptions for individual waste streams. The EPA must now consider a wider range of constituent dangers before "delisting" a waste stream; some 250 temporary and permanent delistings have been granted since 1980. A large scientific burden of proof, therefore, will remain with the EPA as it attempts to promulgate these new waste regulations and testing protocols.

Shift Waste Management Practices from Land Disposal

In amending RCRA, the Congress found that reliance on land disposal of hazardous waste resulted in unacceptable risks to human health and the environment and that advanced treatment, recycling, incineration, and other control technologies should replace land disposal. The 1984 amendments, therefore, contain several provisions designed to shift waste management practices away from currently employed, but unsafe, land disposal methods. Other provisions impose more stringent technological requirements on land and other disposal techniques.

In one of its strongest provisions, the act prohibits, by specific deadlines, land disposal of free liquids, solvents, dioxins, cyanide and metal liquids, acids, PCBs, and halogenated organics (hereafter called "high priority" wastes). The new, so-called "hammer" provisions require the EPA to review all of its approximately 400 listed wastes, as well as those wastes identified by characteristics, and to decide if it is safe to permit continued land disposal. One-third of these wastes will be restricted from using any type of land disposal--except a double-lined landfill--within 45 months of

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4. See *Oversight of Hazardous Waste Management and the RCRA*, hearings before the Senate Subcommittee on Oversight of Government Management of the Committee on Governmental Affairs, 96:1 (July 19 and August 1, 1979).

enactment. The next third will face similar restrictions within 55 months. All wastes will be banned from all forms of land disposal within 66 months of enactment. These land disposal limitations are expected to induce a shift toward the development and use of safer treatment alternatives, such as chemical treatment to reduce hazards, incineration to destroy wastes, or chemical stabilization to prevent migration into groundwater. [5]

The EPA may choose not to ban specific wastes from land disposal, however, if the agency determines that:

- Hazardous constituents will not migrate from the disposal unit or injection zone for as long as the wastes remain hazardous;
- The hazardous waste meets an EPA-determined treatment standard that has substantially reduced the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized; or
- Adequate alternative treatment, recovery, or disposal capacity to protect human health is not yet available.

More stringent technological requirements will apply to those wastes that are permitted to be placed in or on the land. Minimum standards for landfills and surface impoundments will include use of double liners, groundwater monitoring, leak detection, and leachate collection. Variances from these requirements will be allowed only if it can be demonstrated that an alternative design is at least as effective as the liners and leachate collection systems. Land disposal permits will also be contingent upon appropriate corrective action for releases of hazardous waste or its constituents from any part of the disposal facility, regardless of when the waste was placed on site. The act also prohibits, within six months of enactment, disposal of wastes by injection into or above drinking-water aquifers.

Finally, the EPA must also set appropriate public health standards for regulating the transportation of hazardous waste blended with fuel oil and the burning of such waste in industrial boilers. These provisions are designed to end the practice of burning 10 MMT to 20 MMT of hazardous waste per year in industrial boilers under conditions less stringent than those

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5. The "no migration" standard to which the EPA must adhere in judging the suitability of wastes for land disposal technologies might compel the EPA, in certain instances, to ban the land disposal of particular waste types in favor of treatment technologies such as incineration of hazardous wastes. Incomplete incineration of wastes near population centers, however, could present greater potential public health risks.

required for commercial hazardous waste incinerators. Regulations will also curtail the disposal of unknown quantities of hazardous wastes merely by blending this waste with fuel oil and selling the blend to unsuspecting residential customers.

Regulate Underground Storage Tanks

The 1984 amendments establish a significant new regulatory program to protect groundwater--the regulation of underground storage tanks. The act extends RCRA's authority to cover chemical substances stored underground before use in production or resale. It directs the EPA to promulgate regulations on release detection and prevention and corrective action applicable to owners and operators of underground storage tanks. [6] These provisions are a necessary first step to begin regulating the approximately 1.4 million underground gasoline storage tanks, an estimated 7 percent of which could be leaking. [7] An unknown number of active and abandoned chemical and chemical waste storage tanks also will be subject to the new regulations.

EFFECTS OF CHANGES ON WASTE GENERATION, MANAGEMENT, AND COSTS

Assessing the effects of the 1984 amendments on waste generation and management practices relies on basic assumptions about the speed with which the EPA promulgates new regulations and how quickly industrial firms respond (see Table 10). This analysis assumes that the EPA will meet all the act's deadlines. (Although the agency's recent history with RCRA deadlines is poor, it would be arbitrary to assume otherwise.) It also assumes that businesses employ those management strategies that cost the least. Under these conditions, the full effects of the new law would not be felt until 1990. At that time, CBO estimates that total annual waste generation could be as high as 280 MMT or as low as 229 MMT, depending on whether industry fails or succeeds in reducing its waste generation rate. Inflation-adjusted compliance costs for industry would rise from the 1983 baseline level of $5.8 billion a year (or the $6.1 billion that would be incurred in 1990 without the new law's requirements) to between $8.4 billion and $11.2 billion in 1990, again depending on the amount of waste generated. Costs, therefore, would increase over 46 percent from 1983 levels, even under the most favorable assumptions about industrial response and waste reduction efforts.

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[6] These substances include petroleum, gasoline, and other substances listed under Section 101(14) of the Superfund act.

[7] Congressional Research Service, *Leaking Underground Storage Tanks: A Potential Environmental Problem* (January 11, 1984).

TABLE 10. ASSUMED REGULATORY ACTIONS BY EPA UNDER THE 1984 RCRA AMENDMENTS

Waste	Assumed EPA Regulatory Action	Major Technology Shifts Implied
Waste Oils	Blending and burning regulated	Limited increase in refining
Halogenated Solvents	Ban on land disposal	Increased incineration
Nonhalogenated Solvents	Ban on land disposal	Increased incineration
Other Organic Liquids	Ban on land disposal	Increased incineration; increased treatment
Metal Containing Liquids	Ban on land disposal	Limited metal recovery; increased chemical treatment
Cyanide and Metal Liquids	Ban on land disposal and injection well	All wastes oxidized; sludges stabilized
Nonmetallic Inorganic Liquids	Ban on land disposal unless stabilized	Increased stabilization; reduced injection well
Oily Sludge	No action	Increased land treatment
Halogenated Organic Sludge	Ban on land disposal	Increased incineration
Nonhalogenated Organic Sludge	Ban on land disposal unless stabilized	Increased incineration and stabilization
Metal Containing Sludge	Ban on land disposal unless stabilized	Increased dewatering and stabilization
Cyanide and Metal Sludge	Ban on land disposal unless stabilized	Increased stabilization
Nonmetallic Inorganic Sludge	No action	None
Contaminated Clay, Soil, Sand	No action	Limited stabilization
Dye and Paint Sludge	Ban on land disposal unless stabilized	Increased solvent extraction and incineration
Resins, Latex, Monomer	No action	Limited increase in incineration
Metallic Dusts and Shavings	Some wastes banned from sanitary landfill	Some wastes to secure landfill
Nonmetallic Inorganic Dusts	Some wastes banned from sanitary landfill	Some wastes to secure landfill
Halogenated Organic Solids	Banned from land disposal unless stabilized	Increased stabilization and incineration
Nonhalogenated Organic Solids	No action	None
Pesticides, Herbicides	Ban on land disposal of liquids	Increased incineration
PCBs	Ban on land disposal	Incineration of all PCBs
Explosives	No action	Limited increase in stabilization

SOURCE: Congressional Budget Office.

The Potential for Waste Reduction

If industries make no effort to reduce their current levels of hazardous waste generation, the national volume of hazardous waste could rise from 266 MMT in 1983 to about 280 MMT in 1990, roughly a 6 percent increase. (Projected increases in industrial output would cause the increase in wastes.) But the 1984 amendments' prohibition on land disposal of certain waste types is expected to encourage industries to reduce the volume of waste they generate, possibly to as low as 229 MMT by 1990. Their alternative would be to use more expensive means of disposal than commonly employed today. These waste reduction incentives could easily disappear in an atmosphere of regulatory uncertainty, however. Limited federal and state resources could hinder implementation of the act's many new requirements (see Table 9). Some industry managers might delay investment in waste reduction measures until all the act's requirements finally take effect. Industrial efforts to reduce wastes, therefore, will vary from plant to plant, so that the actual national aggregate waste total probably will fall between the no waste reduction (280 MMT in 1990) and maximum waste reduction (229 MMT in 1990) cases presented in this chapter.

Because of the land disposal ban stipulated in the amendments, the unit costs of management for many of the banned wastes probably will rise, in some cases quite dramatically. Thus, many industries will try to employ less expensive water and waste-reduction techniques to help lower their total waste disposal burden (see box). Essentially, three approaches exist for reducing the amount of waste subject to disposal regulations: extract and reuse water from diluted, high-volume waste streams containing hazardous constituents; substitute nonhazardous compounds for hazardous components in waste-producing processes (for example the use of water instead of petroleum-based solvents in paint production); and change in-plant processes to recover and reuse or resell hazardous compounds used during production. Although conditions and opportunities for waste reduction will vary greatly with the type, age, and location of each industrial plant, reasonable estimates of waste reduction can be made on the basis of CBO's waste typology presented in Chapter II. These estimates appear in Table 11. Geography can also affect a firm's incentive to seek waste reductions, as some plants are located in regions where geological conditions could qualify for legitimate exemptions from the new act's land disposal prohibitions. These firms will be less inclined to reduce their reliance on land disposal or to reduce waste generation.

Under the most optimistic set of assumptions, hazardous waste generation in the aggregate could be reduced by some 14 percent from the 1983 level of 266 MMT to 229 MMT by 1990 (see Table 12). This maximum reduc-

WASTE REDUCTION BENEFITS AND BARRIERS TO CHANGE

Federal environmental legislation in the 1970s and 1980s encouraged end-of-pipe waste treatment methods, rather than waste reduction measures, to control air and water pollutants. Regulators favored end-of-pipe technologies because they were easy to enforce. From industry's perspective, this type of treatment offered tax advantages and produced easily measurable results--benefits not generally attributed to alternative means of regulatory compliance, such as waste reduction. End-of-pipe treatment methods often resulted, however, in the transfer of waste residuals from one environmental medium to another. Waste reduction measures, on the other hand, lower the chances of human exposure to toxic substances by eliminating waste residuals altogether.

In-plant waste reduction requires changes such as product reformulation, process modification, equipment redesign, recovery of waste materials for reuse, and waste separation for exchange or resale. Although use of such techniques may not be common as yet, numerous reports chronicle the benefits of waste reduction within large and small industries in all manufacturing sectors. For example, Allied Chemical's Metropolis, Illinois, works used to generate 12,000 metric tons of sludge a year. In 1982, facing limited space to expand its nearly full surface impoundment, Allied discovered a way to recover and reuse the principal constituent in the sludge--calcium fluoride. Generation was reduced by 80 percent, and savings from recovered calcium flouride will allow the facility to pay for itself in four years. On a smaller scale, a 35-employee Baltimore electroplating shop cut water use in half with a $1,650 investment in production line alterations, saving $3,000 a year in water and chemical costs.

Nevertheless, industry has introduced only limited applications of waste reduction technologies, despite the clear economic and environmental benefits of using them. A number of impediments contribute to this limited usage. Regulations tend to encourage and credit only end-of-pipe treatment, often coupled with inconsistent enforcement and numerous exemptions. Attitudinal barriers to changes in conventional end-of-pipe treatment exist among legislators, industries, and professional engineers. In addition, the economic reality of low-cost land disposal has dissuaded many firms from investing in new techniques. Capital availability may also inhibit new investment, especially for small waste generators. Finally, a lack of technical and economic information on the use of waste reduction techniques hinders the introduction of new technologies throughout industry. Without easily available information on other firm's experiences with waste reduction, plant managers may not be aware of new technologies that they could apply to their operations.

TABLE 11. ESTIMATED TARGETS FOR WATER REDUCTION AND MATERIAL RECOVERY THROUGH IMPROVED INDUSTRIAL PROCESSES [a]

Waste Type	Water Reduction Target (percents)	Material Recovery Potential: Material Recovered	Process	Target Recovery (percents)
Liquids				
Waste Oils	0	lubricating oil	rerefining	15
Halogenated Solvents	0	solvents	distillation	80
Nonhalogenated Solvents	0	solvents	distillation	80
Other Organic Liquids	5	organics	steam stripping	20
Metal-Containing Liquids	40	metals	ion exchange/ evaporation	50
Cyanide and Metal Liquids	50	cyanide/ metal solution	reverse osmosis/ evaporation	50
Polychlorinated Biphenols	0	none	--	--
Nonmetallic Inorganic Liquids	20	none	--	--
Sludges				
Oily Sludge	0	crude/ distillates	coker recycle	10
Halogenated Organic Sludge	0	none	--	--
Nonhalogenated Organic Sludge	0	none	--	--
Metal-Containing Sludge	5	metals	varies	5
Cyanide and Metal Sludge	5	metals	varies	5
Nonmetallic Inorganic Sludge	5	none	--	--
Dye and Paint Sludge	5	solvents	ultrafiltration	20
Solids				
Contaminated Clay, Soil, Sand	0	none	--	--
Metallic Dusts and Shavings	0	metals	magnetic separation/leaching	15
Nonmetallic Inorganic Dusts	0	sulfur	sulfur recovery	10
Halogenated Organic Solids	0	none	--	--
Nonhalogenated Organic Solids	0	none	--	--
Mixed				
Pesticides, Herbicides	10	organics	solvent extraction	60
Explosives	5	none	--	--
Miscellaneous Wastes	5	none	--	--
Resins, Latex, and Monomer	0	resins/latex/ monomer	isolation and process return	70

SOURCE: Congressional Budget Office, based on literature cited in CBO, *Empirical Analysis*.

a. Note that water reduction does not necessarily reduce the risk of environmental contamination. By reducing water use, industry can reduce waste management costs, but residuals for final disposal might be concentrated. Reduction potential could be even greater if individual companies devise innovative, plant-specific reduction measures.

TABLE 12. ESTIMATED CHANGES IN WASTE GENERATION PATTERNS, 1983 AND 1990, RANKED BY WASTE QUANTITY, UNDER ALTERNATIVE CASES (In thousands of metric tons)

Waste Type	Quantity in 1983[a]	1990 Quantity With No Waste Reduction[b]	1990 Quantity With Waste Reduction[c]	Percent Change in 1990 Due to Waste Reduction
Nonmetallic Inorganic Liquids	82,261	89,908	71,705	-12.8
Nonmetallic Inorganic Sludge	28,061	28,177	26,768	-4.6
Nonmetallic Inorganic Dusts	21,120	22,214	19,993	-5.3
Metal-Containing Liquids	19,760	19,983	5,995	-69.7
Miscellaneous Wastes	15,415	16,759	15,921	+3.3
Metal-Containing Sludge	14,497	15,147	13,632	-6.0
Waste Oils	14,249	13,932	11,842	-16.9
Nonhalogenated Solvents	12,130	11,869	10,682	-11.9
Halogenated Organic Solids	9,784	11,558	11,558	+18.1
Metallic Dusts and Shavings	7,733	8,112	6,895	-10.8
Cyanide and Metal Liquids	7,383	7,284	1,821	-75.3
Contaminated Clay, Soil, Sand	5,461	5,748	5,748	+5.3
Nonhalogenated Organic Solids	4,578	5,227	5,227	+14.2
Dye and Paint Sludge	4,236	4,112	3,086	-27.1
Resins, Latex, and Monomer	4,018	4,586	4,357	+8.4
Oily Sludge	3,734	3,556	3,200	-14.3
Halogenated Solvents	3,479	3,803	3,423	-1.6
Other Organic Liquids	3,435	3,755	2,817	-18.0
Nonhalogenated Organic Sludge	2,242	2,478	2,478	+10.5
Explosives	720	821	780	+8.3
Halogenated Organic Sludge	715	683	683	-4.5
Cyanide and Metal Sludge	557	593	505	-9.3
Pesticides, Herbicides	26	28	24	-7.7
Polychlorinated Biphenols	1	1	1	0.0
Total[d]	265,595	280,364	229,141	
Percent change from 1983	--	+5.6	-13.7	

SOURCE: Congressional Budget Office.

a. Mean estimate of waste generation under previous RCRA policies (see Table 3 in Chapter II).

b. Assumes no waste reduction efforts by industry in response to 1984 RCRA amendments. Projection of waste generation levels in 1990 based on growth in industrial output levels forecast by CBO's generation model. Decreases in waste quantities therefore result from declining levels of industrial (and waste-producing) activity.

c. Assumes waste-reduction efforts by industry, as detailed in Table 11. Forecast includes waste growth from increases in industrial output identical to that of the higher 1990 waste-reduction case.

d. Columns may not add to totals because of rounding.

tion case includes expected growth in the number of wastes covered by regulations (as required by certain provisions of the 1984 amendments) and additional wastes generated because of increases in industrial output projected through 1990. Creation of liquid hazardous wastes could fall most dramatically. Sludge generation could also decrease somewhat, while generation of solid hazardous wastes would be largely unaffected. Thus, industries with a high proportion of liquid wastes could experience the greatest percent of waste reductions (see Table 13). The fabricated metal products industry, for example, could lower waste generation by an estimated 54 percent.

It is important to note that waste reduction is not mandated and thus need not occur under the new law. Industry could delay taking any action, for example, until the EPA issues final regulations, some of which could take six to eight years. Capital formation constraints, especially for small generators, could also inhibit rapid waste reduction. If this were the case, waste generation in 1990 could be as high as 280 MMT and could cost industry roughly twice as much to manage as it does today.

Possible Changes in Waste Management Practices

While the 1984 amendments might encourage waste reduction, land disposal bans definitely will require changes in waste management practices. As land disposal bans and other tougher requirements are imposed, advanced treatment technologies and presumably safer disposal techniques should be used more and land disposal methods less. By 1990 the direct disposal (no pretreatment) of hazardous waste into hazardous waste landfills, injection wells, and surface impoundments should fall by 35 percent, 24 percent, and 77 percent, respectively, assuming no waste reduction occurs (see Table 14). If industry chooses waste or water reduction options, the use of these land-based technologies could be decreased even further. Reduction in the use of injection wells might proceed more slowly, however, because the amendments do not foreclose this option as quickly as other banned forms of land disposal.

By 1990 such advanced technologies as incineration, chemical oxidation, and waste stabilization should rise by at least 204 percent, 73 percent, and 66 percent, respectively. (See Table 5 in Chapter II for descriptions of these methods.) The shift into incineration is the single greatest change expected. Between 8 MMT and 12 MMT of organic liquids and sludges could be incinerated by 1990, compared with only about 3 MMT in 1983. Stabilization of organic and inorganic sludges to prevent migration also is expected to increase substantially, because of assumed regulatory actions taken by EPA (see Table 10). Changed regulatory requirements also should reduce the quantities of inorganic solids that enter sanitary landfills.

TABLE 13. ESTIMATED CHANGES IN WASTE GENERATION PATTERNS, 1983 AND 1990, BY MAJOR INDUSTRY GROUP, UNDER ALTERNATIVE CASES (In thousands of metric tons)

Major Industry	Quantity in 1983 [a]	1990 Quantity With No Waste Reduction [b]	1990 Quantity With Waste Reduction [c]	Percent Change in 1990 from Waste Reduction
Chemicals and Allied Products	127,245	136,678	115,167	-9
Primary Metals	47,704	49,597	41,611	-13
Petroleum and Coal Products	31,358	29,213	25,526	-19
Fabricated Metal Products	25,364	25,493	11,820	-54
Rubber and Plastic Products	14,600	17,954	17,252	+18
Miscellaneous Manufacturing	5,614	5,856	5,001	-11
Nonelectrical Machinery	4,859	5,717	4,831	-1
Transportation Equipment	2,977	3,243	2,781	-7
Motor Freight Transportation	2,160	2,160	1,836	-15
Electrical and Electronic Machinery	1,929	2,313	1,557	-19
Wood Preserving	1,739	2,095	1,743	0
Drum Reconditioners	45	45	16	-64
Total	265,595	280,364	229,141	
Percent change from 1983	--	+5.6	-13.7	

SOURCE: Congressional Budget Office.

a. Mean estimate of waste generation under pre-1984 RCRA policies (see Table 3 in Chapter II).

b. Assumes no waste reduction efforts by industry in response to 1984 RCRA amendments. Projection of waste generation levels in 1990 based on growth in industrial output levels forecast by the CBO generation model. Decreases in waste quantities therefore result from declining levels of industrial (and waste-producing) activity.

c. Assumes waste-reduction efforts by industry, as detailed in Table 11. Forecast includes waste growth from increases in industrial output identical to that of the higher 1990 waste-reduction case.

TABLE 14. ESTIMATED WASTE FLOWS BY MANAGEMENT TECHNOLOGY, 1983 AND 1990, UNDER ALTERNATIVE CASES (In millions of metric tons)

Technology	Quantity in 1983 [a]	1990 Quantity With No Waste Reduction [b]	1990 Quantity With Waste Reduction [c]
Injection Well	66.8	50.7	41.6
Sewers and Direct Discharge [e]	58.9	60.9	36.7
Surface Impoundment	49.5	11.2	10.8
Hazardous Waste Landfill			
No pretreatment	34.2	22.2	22.2
With stabilization	d	70.7	66.1
Sanitary Landfill	26.7	11.3	10.7
Distillation	10.9	11.0	9.5
Industrial Boilers	9.5	12.1	9.0
Oxidation	3.0	7.6	5.2
Land Treatment	2.9	5.7	4.8
Incineration	2.7	11.6	8.2
Ion Exchange	0.5	0.9	0.5
Solvent Extraction	d	0.9	0.9
Oil Rerefining	d	2.8	2.4
Metal Recovery	d	1.2	0.5
Total	265.6	280.8	229.1
Percent Change from 1983	--	5.6	-13.7

SOURCE: Congressional Budget Office.

a. Mean estimate of waste generation under pre-1984 RCRA policies (see Table 3 in Chapter II).

b. Projection based on no waste reduction 1990 case in Table 12.

c. Projection based on waste reduction case in Table 12.

d. Less than 0.5 million metric tons.

e. Wastes entering this category are treated residuals from other treatment and disposal processes or wastes disposed of in compliance with Clean Water Act regulations, which should pose little or no threat to the environment.

In addition, the new law should cause a shift toward off-site management. The CBO estimates that some 96 percent of all waste was managed on-site in 1983. Under the 1984 amendments, however, many more small producers of hazardous waste that find it economic to use off-site facilities will be included under the regulations, and many waste generators previously using substandard on-site land disposal facilities will ship their newly banned wastes to off-site treatment plants. Consequently, the percentage of waste managed off-site should increase from 4 percent in 1983 to 10 percent in 1990. This could raise the total volume of waste managed off-site from 10.3 MMT in 1983 to between 17.6 MMT (assuming waste reduction occurs) or 25.3 MMT (assuming waste reduction does not occur) in 1990. If no new off-site facilities are built by 1990, the increased demand for off-site services--together with additional demands for off-site treatment and disposal engendered by an expanded Superfund cleanup program--could easily overwhelm current capacity in the commercial treatment industry, particularly for incineration and chemical oxidation services. (Although excess capacity now exists, the difficulty in siting and obtaining permits could constrain development of new, advanced treatment facilities in time to meet new demand.) [8]

Costs of the 1984 Amendments to Industry

If the 1984 amendments to RCRA had not passed and no further changes to the law occurred before 1990, inflation-adjusted annual compliance costs would be expected to increase to $6.1 billion from the 1983 level of $5.8 billion, a 5 percent rise. But the land disposal prohibitions in the 1984 amendments will increase industrial compliance costs significantly, by requiring firms to employ more advanced treatment and disposal methods. In the absence of waste reduction, compliance costs could reach $11.2 billion (in 1983 dollars) in 1990, nearly double 1983 levels (see Table 15). Faced with these higher costs, however, industry might seek to reduce waste output. Under the most favorable assumptions regarding industrial responsiveness, such waste reduction measures could limit industry's compliance costs to a 46 percent increase (to $8.4 billion) in 1990 over 1983 levels. The use of available tax benefits, such as investment tax credits and accelerated depreciation of capital equipment (not considered in this analysis) also could reduce certain firms' compliance costs significantly for both the waste reduction and no waste reduction cases.

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8. See, for example, projections of future incinerator requirements contained in EPA, Office of Policy, Planning and Evaluation, *Assessment of Incineration As A Treatment Method for Liquid Organic Hazardous Wastes* (March 1985).

TABLE 15. ESTIMATED RANGE OF ANNUAL INDUSTRIAL EXPENDITURES FOR HAZARDOUS WASTE MANAGEMENT, 1983 AND 1990, UNDER ALTERNATIVE CASES (In millions of 1983 dollars)

Major Industry	Cost in 1983 [a]	1990 Cost With No Waste Reduction [b]	1990 Cost With Waste Reduction [c]
Chemicals and Allied Products	1,544	3,122	2,283
Primary Metals	1,243	2,302	1,661
Fabricated Metal Products	899	1,191	735
Rubber and Plastic Products	798	2,026	1,771
Miscellaneous Manufacturing	267	356	308
Nonelectrical Machinery	254	324	279
Motor Freight Transportation	229	247	247
Transportation Equipment	191	360	286
Electrical and Electronic Machinery	156	237	163
Petroleum and Coal Products	136	940	634
Wood Preserving	56	91	61
Drum Reconditioners	6	6	2
Total	5,779	11,201	8,429
Incremental Change from 1983		5,422	2,650
Percent Change from 1983	--	+93.8	+45.8

SOURCE: Congressional Budget Office.

a. Assumes full compliance with RCRA regulations before the 1984 amendments.

b. Projection based on no waste reduction case in Table 12.

c. Projection based on waste reduction case in Table 12.

In addition to strengthening the requirements governing land disposal, the 1984 amendments are expected to raise industry's costs in other ways (see Table 9 for regulatory changes). Regulations governing land disposal should account for the bulk of increased costs, though. They are projected to cost industry an extra $2.6 billion to $5.4 billion a year, depending on whether and how much industry reduces its aggregate waste generation. The EPA also estimates that the retrofit requirements for hazardous waste landfills and surface impoundments and new regulations for sanitary landfills (so-called "Subtitle D" facilities) could add between $1 billion and $2 billion per year, although these costs are uncertain. In addition, facilities that burn hazardous waste with fuel in industrial boilers will face stricter notification and recordkeeping requirements, adding roughly $0.5 billion to $1.6 billion annually to industry's disposal costs. Finally, the change in the small generator threshold for waste production, adding about 130,000 firms to regulatory oversight, should cost industry between $100 million and $300 million per year. Table 16 summarizes these expected changes in compliance costs.

Industries Affected by 1984 Amendments

Industry's success in achieving its maximum waste reduction potential will primarily determine how much, if any, compliance costs will increase as a result of the 1984 RCRA amendments. As under the previous law, the chemical and allied products group is expected to spend the most for hazardous waste management. Under the new law, their costs should rise from about $1.5 billion in 1983 to between $2.3 billion and $3.1 billion in 1990 (see Table 15), depending on the aggregate level of industry waste reduction or increase by 1990. Some industries with greater relative waste reduction potential than others might actually experience declining costs by 1990. For example, compliance costs for the fabricated metal products group, could decline from $899 million in 1983 to $735 million in 1990, if the new amendments to RCRA encourage firms in the industry to realize their large potential for waste reduction.

Total expenditures for hazardous waste management do not necessarily indicate the relative cost burdens across industries, however. Thus, although the chemicals and allied products group is expected to spend the most for waste management under the 1984 amendments, the wood preserving industry appears to be the hardest hit in terms of the percent of sales devoted to disposal costs (see Table 17). In that industry, an additional 2.6 cents for every dollar of sales will have to be devoted to hazardous waste management. On average, the new law will require industries to devote an additional 1.3 percent of every sales dollar, for a 2.6 percent total in 1990, to hazardous waste disposal, assuming no reduction in generated waste. Under the optimistic assumption about waste reduction, incremental costs could be reduced to just 0.6 percent of sales on average, for a 1.9 percent total in 1990. The fabricated metal products industries would benefit the most from shifting into waste reduction, experiencing an actual reduction in its expenditure to sales ratio from 2.3 percent in 1983 to only 1.9 percent in 1990.

The percentage of industry-wide profits spent on incremental expenditures is a second measure of relative burden under the 1984 amendments. A high percentage implies either reduced profits, reduced output, increased product prices, or some combination. If prices cannot be passed on to product consumers--because of competition from foreign producers not facing

TABLE 16. RANGE OF ESTIMATED ANNUAL INCREMENTAL COSTS TO INDUSTRY OF 1984 RCRA AMENDMENTS, BY 1990 (In millions of 1983 dollars)

Program Element	Annual Cost
Land Disposal Prohibition	2,650--5,422
Sanitary Landfill (Subtitle D) [a]	1,000--2,000
Burning and Blending Requirement [b]	456--1,620
Small Generators [b]	100--300
New Technological Requirements [b]	40--75
Total	4,246--9,417

SOURCE: Congressional Budget Office, in part based on data obtained from the Environmental Protection Agency.

a. The Subtitle D program includes retrofit requirements for sanitary landfills, such as municipal solid waste landfills. Program costs are uncertain, because it is difficult to predict how many facilities will be required to meet the more stringent standards applicable to hazardous waste landfills. The estimate in this table, therefore, does not include any of the corrective action requirements of new RCRA Section 3004(t). Assuming all Subtitle D facilities must install groundwater monitoring systems, corrective action (40 CFR 264.100) is required at only 20 percent of municipal facilities and 10 percent of industrial facilities, and liners are required at 20 percent of municipal sites and 5 percent of industrial facilities, annual costs could increase by $4 billion to $7 billion. Full application of current hazardous waste landfill standards to all Subtitle D facilities could increase annual costs by $10 billion to $25 billion.

b. Estimated by the Environmental Protection Agency, Office of Policy Analysis (1984).

TABLE 17. PERCENT OF INDUSTRY SALES SPENT FOR HAZARDOUS WASTE MANAGEMENT, 1983 AND 1990, UNDER ALTERNATIVE CASES [a]

Major Industry	Percent in 1983 [b]	1990 Percent With No Waste Reduction [c]	1990 Percent With Waste Reduction [d]
Wood Preserving	4.1	6.7	4.5
Fabricated Metal Products	2.3	3.1	1.9
Chemicals and Allied Products	1.8	3.7	2.7
Rubber and Plastic Products	1.4	3.6	3.1
Primary Metals	1.0	1.9	1.3
Miscellaneous Manufacturing	0.9	1.2	1.0
Nonelectrical Machinery	0.3	0.4	0.3
Electrical and Electronic Machinery	0.3	0.5	0.3
Petroleum and Coal Products	0.1	0.5	0.4
Transportation Equipment	0.1	0.2	0.1
Motor Freight Transportation	e	e	e
Drum Reconditioners	e	e	e
Weighted Average	1.3	2.6	1.9

SOURCE: Congressional Budget Office.

a. Percent in 1990 under 1984 amendments to RCRA. RCRA regulations are assumed to change to comply with the 1984 amendments on schedule.

b. Assumes full compliance with RCRA regulations before the 1984 amendments.

c. Projection based on no waste reduction 1990 case in Table 12.

d. Projection based on waste reduction case in Table 12.

e. Sales data are not available.

increased regulatory compliance costs, for example--a high percentage could indicate that marginal plants within the industry might have to close or reduce production. [9] In the absence of any waste reduction measures, the incremental cost burden of the 1984 amendments relative to estimated 1990 profit levels would be borne most by the following industries: wood preserving, 111 percent; primary metals, 64 percent; and rubber and plastic products, 52 percent.

Waste reduction measures could reduce these incremental cost burdens substantially (see Table 18). For example, the achievement of maximum waste reduction potential in the wood preserving industry would lower the expenditure to profit ratio from 111 percent to only 16 percent; for primary metals, it would fall from 64 percent to 25 percent. All of these expenditure estimates omit the effects of investment tax credits and capital equipment depreciation, which could lower significantly the net, after-tax cost of management for individual firms. The expenditures to profits ratios also do not consider the costs of output losses to these industries, or the potential disposal cost savings from reduced flows of hazardous waste that could result from output losses.

Cost to Federal, State, and Local Governments

The 1984 amendments should increase administrative costs at all levels of government. Compared with outlays of $175 million in fiscal year 1984 for EPA's hazardous waste program, authorizations for fiscal year 1985 under the new law are $234 million, or a 34 percent real increase (see Table 19). The statute creates significant new federal responsibilities in hazardous waste management under the new leaking underground storage tank program and the reactivation of the sanitary landfill control program. Roughly $10 million a year is authorized for federal activities and $45 million a year for state grants in these two areas through fiscal year 1988. Additional new budget authorization is provided for an inventory of hazardous waste facilities operated by federal agencies.

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[9] From a purely economic standpoint, plant closures for industries or firms unable to cleanup their wastes efficiently might be a desirable result. Regulatory or tax changes (such as the 1984 RCRA amendments or waste taxes examined in Chapter IV) that ensure that firms' waste management and cleanup costs are reflected in product prices would lead to increases in the prices firms must charge to remain profitable. Given sufficient consumer demand (and no additional competing imports), these price increases would yield stable or increased revenues to firms. Society's demand for the firms' products would more than compensate for increases in waste management costs. If demand for such products declined significantly in response to the induced price increases, however, the affected industrial sectors or firms would contract or go bankrupt. The most waste-intensive industries, that is, those with the highest expenditure ratios, such as the wood preserving industry, would be the most adversely affected. Domestic production of such waste-intensive products might therefore decline. In effect, pollution would be exported to countries with less stringent waste controls or taxes.

It is not clear what additional costs, if any, the new law will impose on state governments. The delegation to the states of responsibilities for hazardous waste programs has been a major focus of EPA's efforts under RCRA and that focus is expected to be continued under the 1984 amendments. Authorizations for state grants under the new law, steady at $60 million from fiscal years 1986 through 1988, represent a 20 percent real increase over the $47 million in hazardous waste grants in 1984. Depending on the degree of program delegation to the states, this increased level of funding might or might not match the corresponding increase in states' responsibilities.

TABLE 18. ESTIMATED INCREMENTAL HAZARDOUS WASTE MANAGEMENT EXPENDITURES UNDER THE 1984 RCRA AMENDMENTS, AS A PERCENT OF ESTIMATED 1990 PROFITS, BY MAJOR INDUSTRY GROUP, UNDER ALTERNATIVE CASES

Major Industry	Without Waste Reduction [a]	With Waste Reduction [b]
Wood Preserving	111.0	15.6
Primary Metals	64.2	25.3
Rubber and Plastic Products	52.3	41.4
Chemicals and Allied Products	44.6	20.9
Petroleum and Coal Products	33.8	20.9
Fabricated Metal Products	28.1	c
Miscellaneous Manufacturing	8.7	4.0
Electrical and Electronic Machinery	3.2	c
Transportation Equipment	2.9	1.6
Nonelectrical Machinery	1.9	1.0
Drum Reconditioners	c	c
Motor Freight Transportation	d	d

SOURCE: Congressional Budget Office, based in part on profit to sales ratios found in Dun and Bradstreet, *Industry Ratios and Financial Norms* (1983-1984) edition.

a. Projection based on no waste reduction case in Table 12.
b. Projection based on waste reduction case in Table 12.
c. Less than 1 percent.
d. Profit to sales data are not available.

Local government expenditures could also increase. The 1984 amendments require the EPA to upgrade the RCRA criteria for sanitary landfills as necessary to protect public health and the environment. Many such landfills are owned and operated by local governments. Although it is not clear how the EPA will choose to regulate these facilities, the authority exists (or the need may arise) for the agency to require that the 12,000 to 18,000 municipally owned sanitary landfills nationwide comply fully with more stringent hazardous waste landfill standards. However unlikely such an action might be, requiring groundwater monitoring, leachate collection, and corrective actions at all such facilities could cost $10 billion to $25 billion. It is unclear how these costs would be shared by local governments and sanitary landfill users.

TABLE 19. AUTHORIZATION LEVELS IN 1984 RCRA AMENDMENTS, FISCAL YEARS 1985 THROUGH 1988 (In millions of dollars)

Program Element	1985	1986	1987	1988
General	70.0	80.0	80.0	80.0
State Hazardous Waste Programs	55.0	60.0	60.0	60.0
Federal Hazardous Waste Site Inventory	25.0	25.0	25.0	25.0
Development and Implementation Aid	10.0	10.0	10.0	10.0
Implementation Assistance	10.0	10.0	10.0	10.0
Special Communities	0.5	0.5	0.5	0.5
State Recycled Oil Programs	5.0	5.0	5.0	5.0
Department of Commerce Functions	1.5	1.5	1.5	1.5
Criminal Investigators	3.3	2.4	2.5	2.5
Small Quantity Generator Education	0.5	0.5	0.5	0
Federal Underground Storage Tank Program	10.0	10.0	10.0	10.0
Leaking Underground Storage Tank Program (Grants to States)	25.0	25.0	25.0	25.0
State Compliance with Open Dumping/ Sanitary Landfill Criteria	15.0	20.0	20.0	20.0
National Groundwater Commission	3.0	4.0	0	0
Total	233.8	253.9	250.0	249.5

SOURCE: Congressional Budget Office, based on Conference Report to Accompany H.R. 2867, the Hazardous and Solid Waste Amendments of 1984, Report No. 98-1133, 98:2 (October 3, 1984), p. 80.

CONCLUSIONS

The 1984 Solid and Hazardous Waste Amendments sought, through the imposition of stringent regulations, to discourage and limit the disposal of wastes in and on the land and attempted to shift management practices toward more advanced, waste-reducing technologies. The act is expected to increase industry's future disposal costs and potentially lower the amount of waste generated. If shortcomings exist under the new law, they could arise from the failure to provide direct incentives for generators to reduce their waste flows before the land disposal prohibition deadlines; from the absence of any mechanisms to ensure that adequate treatment capacity will be available when the land disposal prohibitions take effect; and from the costly administrative and enforcement burden imposed on federal and state governments by the act's new regulations. Equally important, the revenues needed for the federal Superfund program--designed to cleanup uncontrolled waste sites--were not addressed by the amendments.

CHAPTER IV

STRENGTHENING THE FEDERAL SYSTEM FOR HAZARDOUS WASTE MANAGEMENT

The 1984 amendments to the Resource Conservation and Recovery Act closed many regulatory loopholes that impeded progress toward the act's goals. Although many problems were remedied in this legislation, as illustrated in the preceding chapter, several remain, including the following:

- The incentives to reduce the generation of waste--a goal stipulated in the act--might be too limited or indirect to achieve this objective.
- The regulatory and administrative responsibilities placed on federal and state governments by the amendments might be too onerous under current budgetary constraints;
- Financial and institutional impediments could hinder the development of additional off-site commercial facilities using advanced treatment technologies, which are needed to meet the goals of the amendments; and
- Revenues might be insufficient to help pay for the eventual cleanup of some 1,400 to 10,000 uncontrolled waste sites under the Superfund program.

Combined, these problems could hamper achieving the goals of the 1984 amendments: the reduction of waste generation, the protection of health and the environment, and the prevention of new Superfund sites created by mismanagement of today's industrial wastes. This chapter examines several alternatives designed to address these concerns. Three basic sets of options are presented:

- Taxes on hazardous waste designed to encourage the reduction of waste generation at the point of production;
- Various other revenue-raising proposals to enable continued site cleanup under the federal Superfund law; and
- Other measures to assist industry and government agencies in meeting the requirements of the new law.

The last measures could be applied in conjunction with either of the first two alternatives, since they would reduce the governmental burden of the new law, and ease the financial and institutional constraints of constructing new commercial facilities using advanced treatment technologies.

The results of this examination indicate that taxes on newly generated hazardous waste (so-called "waste-end taxes") would significantly encourage hazardous waste reduction and support shifts to the new technologies desired under the new law. They also would provide revenues that could bolster substantially--at least for a short period--the Superfund program. [1] Because waste reduction measures induced by waste-end taxes would lead to an erosion in this tax base, however, such taxes will not serve as a stable Superfund revenue source for a long period. If revenues are the major concern, an increase in the current feedstock tax, the institution of a tax on corporate receipts, or the use of general revenues would provide more adequate and more certain funding for Superfund than waste-end taxes.

HAZARDOUS WASTE MANAGEMENT: REMAINING ISSUES

As described in the preceding chapters, the 1984 RCRA amendments and the original Superfund law represent two parts of a federal system for hazardous waste management: the RCRA is designed to ensure the proper disposal of new wastes and the Superfund is designed to ensure the cleanup of uncontrolled, unsafe sites. To meet the goals of the RCRA, the 1984 amendments banned the land disposal of certain wastes and placed more stringent technological requirements on many other waste management practices. These changes should increase waste management costs, both for private industry and for federal and state governments. Such regulations also could encourage limited waste reduction efforts, but the act's incentives are unlikely to elicit as strong an industrial response as would a direct economic incentive like waste-end taxes. Because waste reduction can be an effective proxy for reducing the environmental hazards potentially created by waste disposal activities, failure by industry to achieve its maximum waste reduction potential could lead to greater public health risks and the emergence of new Superfund sites in the future.

The problems related to the Superfund law are more immediate, because legislative and revenue-raising authority expire at the end of fiscal

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1. Unlike the current Superfund tax scheme, which taxes a limited group of chemical feedstocks, waste-end tax systems would tax the generation or disposal of a larger group of industrial hazardous wastes, some of which could include wastes from processes using Superfund feedstock chemicals.

year 1985. The act must be reauthorized if Superfund cleanup efforts are to continue. The EPA expects that fund resources raised under the current law will be exhausted early in 1986, by which time only a fraction of the known priority sites will be cleaned up. Current funding levels support cleanup activities at roughly 35 sites per year, out of a projected total of as many as 10,000 sites eventually requiring remedial action. As the Congress considers reauthorization of the Superfund program, it will face important issues regarding the need for additional site cleanups, alternative approaches for replenishing the fund, the speed and pace of the cleanup effort, and the role of the states in supporting the program.

Current Waste Reduction Incentives Possibly Inadequate

The 1984 RCRA amendments could provide an incentive for certain industries to reduce waste generation, because the act's prohibitions on land disposal will mandate the use of higher cost, alternative treatment technologies for "banned" wastes. Industries, therefore, might seek to reduce their waste generation rates as a means of reducing total compliance costs.

But these waste reduction incentives could easily disappear in an atmosphere of regulatory uncertainty. As noted in Chapter III, limited federal and state resources could hinder implementation of the act's many new requirements (see Table 9 in Chapter III). Industry managers might delay investment in waste reduction measures until all the act's new requirements finally take effect. Moreover, private capital formation problems (especially for small companies) and institutional constraints impeding the development of new off-site commercial treatment facilities could delay the construction of needed treatment capacity, allowing some of the land disposal prohibitions to be waived. Therefore, additional measures might be necessary to stimulate industrial waste reduction efforts, or waste production levels could rise somewhat from current ones.

Possible Shortage of New Treatment Capacity

The CBO analysis of the 1984 amendments shows that, even with waste reduction under the new law, demand for off-site commercial treatment capacity is expected nearly to double. This increase should easily outstrip existing treatment capacity, causing shortfalls if new facilities are not built. Public antagonism toward siting new waste disposal facilities near residential neighborhoods could hinder further development of the commercial waste treatment industry, which primarily would affect small waste generators. Capacity shortfalls could pose special problems for small generators new to the federal regulatory system, especially for those lacking the needed resources to purchase and operate their own facilities. In addition, capacity shortfalls could be expected to raise off-site disposal prices for all waste generators.

Large firms in certain hardship industries, such as wood preserving, also might be unable to borrow large sums for nonincome producing investments. For example, a typical incinerator servicing roughly 24,000 metric tons a year of waste (an average flow for the petrochemical industry) may cost between $10 million and $15 million to build. [2] If new disposal capacity cannot be installed by firms, wastes would have to be sent off-site for disposal, adding to the anticipated shortfall.

EPA's Administrative and Enforcement Burden

The Environmental Protection Agency has already begun to develop many of the regulations required by the 1984 RCRA amendments. In light of the agency's somewhat poor performance in meeting the original act's deadlines, however, much concern exists over whether the EPA can handle this dramatically increased load, particularly in a time of mounting state and federal fiscal constraints. By the EPA's own admission, these added responsibilities--including the oversight of 130,000 new small generators--could exacerbate delays in issuing permits for hazardous waste facilities and in enforcement activities. Through 1984 the EPA and states with approved hazardous waste management programs had issued only 968 final permits to the estimated 5,000 treatment, storage, and disposal facilities that eventually will need permits to continue operating. At this rate, completing the process could take seven to ten years. In addition, more than 50 percent of operating hazardous waste facilities have been found to violate groundwater monitoring rules. [3] Because 45 now closed RCRA-regulated facilities have already become Superfund sites, it is unclear whether the EPA can prevent more RCRA-regulated sites from becoming future Superfund candidates. Clearly, the agency's responsibilities for hazardous waste management are straining current resources, and only additional resources or reduced regulatory loads can solve the problem.

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[2] See, for example, Chemical Manufacturers Association, *Comparative Evaluation of Incinerators and Landfills for Hazardous Waste Management*, prepared by *Engineering Science* (1982).

[3] General Accounting Office, *Interim Report on Inspection, Enforcement and Permitting Activities at Hazardous Waste Facilities* (1983). Section 212 of the 1984 RCRA amendments requires all facilities to receive final permits within eight years of enactment.

Additional Revenues Needed for the Superfund

As mentioned previously, the Superfund is responsible for cleaning up abandoned dumpsites posing dangers to groundwater and human health. Current legislative and revenue-raising authority expires at the end of fiscal year 1985, when less than one-fourth of the 800 listed and proposed priority sites will have been restored. The EPA estimates that the total number of sites eventually needing remedial action is 1,400 to 2,200, although the Office of Technology Assessment (OTA) believes as many as 10,000 sites could require cleanup. 4/ Potential cleanup costs range from $10 billion to $100 billion--at least ten times the current authorization level. But the amount of funds needed is not the only issue; the speed at which problem sites are remedied also is important.

If current rates of Superfund spending and taxation continued, it would take 25 to 50 years to restore the additional hazardous waste sites identified by the EPA. Compounding this problem is the possibility that waste management facilities currently regulated under RCRA could eventually become problem sites to be cleaned up by Superfund. As stated, 45 RCRA-regulated (but now inactive) hazardous waste sites have been placed on the National Priority List and await cleanup. Additional closures of RCRA-regulated facilities are expected as a result of the 1984 amendments, some of which could also become Superfund sites.

Moreover, under the 1984 amendments, small generators can continue to place hazardous waste in sanitary (so-called "Subtitle D") landfills until March 31, 1986. 5/ Generators of less than 100 kilograms per month can continue to use such landfills indefinitely, unless the EPA directs otherwise after further study. Most of these sites lack any form of environmental controls that could prevent the release of hazardous constituents to the environment. The OTA estimates that some 2,300 of these facilities (out of a projected total of some 280,000) could require remedial action at a cost of more than $23 billion. 6/

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4. Office of Technology Assessment, *Superfund Strategy* (1985).

5. Subtitle D of RCRA contains guidelines for state and regional solid waste management practices, including landfills that receive only nonhazardous industrial and municipal wastes.

6. In addition to sanitary landfills, there are some 340,000 surface impoundments that receive industrial and municipal wastes that are regulated under Subtitle D. The OTA estimates that 2,700 of them would eventually require Superfund activity at a total cost of about $27 billion. See Office of Technology Assessment, *Superfund Strategy*(1985).

WASTE-END TAXES: THE USE OF ECONOMIC INCENTIVES TO PROMOTE WASTE REDUCTION

Taxing waste generation or disposal methods could provide a strong economic incentive for industry to minimize waste generation and limit its use of land disposal technologies. A tax system would promote transitional steps toward waste or hazard reduction while the regulatory activities contemplated by the 1984 RCRA amendments are implemented by the EPA.

The imposition of high taxes on undesirable management techniques, such as landfills, and lower taxes on preferred waste treatment methods, such as incineration, would move generators away from the use of unsafe land disposal technologies and toward more advanced waste treatment methods. The latter technologies also would become more price competitive through the use of a variable tax system. By raising waste management costs in general, taxes could also stimulate increased waste reduction efforts by industry. This would help reduce the possibility of commercial treatment bottlenecks arising as the land disposal prohibitions take effect. Those generators that choose not to employ more advanced management techniques would pay higher taxes, which could help offset the costs to government and society arising from future cleanup efforts and potential health problems. Consumers of waste-producing industrial products also would share the costs of proper waste management through increases in product prices caused by the tax. Tax revenues could be used to clean up old sites, to provide loans or grants to small generators, to fund enhanced research and development, or to support hazardous waste control efforts by federal and state governments.

Structure of Waste-End Tax Systems

Waste taxes can be assessed either at the point of generation or at disposal, and can be varied to reflect the hazard of a particular waste or waste management practice. To support the intent of RCRA, taxes should be more punitive toward the least desirable disposal options (land disposal, for example) and less punitive toward techniques that destroy waste, lower its content, or reduce its hazard (incineration, for instance). Waste-end taxes can also be used to discourage both the generation of particular wastes more than others and the pairing of certain wastes with particular disposal techniques. These requirements should be balanced, however, against each tax systems' ease of administration and ability to provide stable revenues over time.

This section examines four different tax systems:

- **Tax System 1** varies taxes only on the basis of waste treatment or disposal technology, with a tax structure designed to encourage a shift away from certain undesirable land disposal techniques and toward more advanced treatment methods.

- **Tax System 2** is graduated on the basis of waste hazard, management technique, and disposal method. Tax rates are designed to discourage the pairing of certain wastes with certain treatment methods depending on the hazard potential of the pairing.

- **Tax System 3** (proposed by the Administration) also differentiates simply on the basis of management technology, but unlike Tax System 1, tax rates are increased each year to help assure a stable revenue stream.

- **Tax System 4** makes no distinction among waste hazards or disposal choices, but simply places a flat tax on each unit of waste generated.

All four tax systems would expand considerably the current $2.13 per ton (dry weight) tax levied at qualified hazardous waste disposal facilities for Superfund's Post-Closure Liability Trust Fund. None of the options would apply to wastes that are recycled or reduced as part of the production process. All tax systems are assumed to begin operation in 1986 and, as in Chapter III, full implementation of the 1984 amendments is assumed to occur on schedule. [7]

Tax System 1: Promote Shifts in Waste Management. Tax rates under Tax System 1 would differ only on the basis of waste treatment or disposal technology. No distinction is made on the basis of waste type, waste hazard, or place of disposal (on-site versus off-site). The tax would be graduated to encourage first, waste recycling and incineration; second, pretreatment or stabilization before land disposal; and last, land disposal with no treatment (see Table 20). These distinctions mirror the waste management heirarchy established under the 1984 RCRA amendments. Tax levels were set high enough to erode the previous cost advantage of undesirable management technologies, so that industry would switch to preferred (and, with the tax,

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[7] As an example, industries could not receive an exemption from any ban specified in the 1984 amendments simply by paying the tax. Once banned, a disposal or treatment technology is precluded as a management option, under the assumption of full compliance.

TABLE 20. ALTERNATIVE TAX SYSTEMS FOR ECONOMIC INCENTIVES OPTIONS: TAX SYSTEM 1: TECHNOLOGY BASIS;[a] TAX SYSTEM 2: WASTE HAZARD BASIS;[b] TAX SYSTEM 3: ADMINISTRATION PROPOSAL[c] (In 1983 dollars per metric ton)

Waste Type	Land Disposal No Treatment			Land Disposal Pretreatment or Stabilization			Deep Well Injection		
	1	2	3	1	2	3	1	2	3
Waste Oils	25	60	NA	5	60	NA	NA	NA	NA
Halogenated Solvents	25	60	11	5	60	11	4	60	3
Nonhalogenated Solvents	25	60	11	5	60	11	4	60	3
Other Organic Liquids	25	60	11	5	50	11	4	5	3
Metal-Containing Liquids	25	60	11	5	50	11	4	5	3
Cyanide and Metal Liquids	25	60	11	5	50	11	4	5	3
Nonmetallic Inorganic Liquids	25	60	11	5	50	11	4	5	3
Oily Sludge	25	40	11	5	5	11	NA	NA	3
Halogenated Organic Sludge	25	60	11	5	20	11	NA	NA	NA
Nonhalogenated Organic Sludge	25	20	11	5	10	11	NA	NA	NA
Metal-Containing Sludge	25	60	11	5	30	11	NA	NA	NA
Cyanide and Metal Sludge	25	60	11	5	30	11	NA	NA	NA
Nonmetallic Inorganic Sludge	25	20	11	5	10	11	NA	NA	NA
Contaminated Clay, Soil, Sand	25	20	11	5	10	11	NA	NA	NA
Dye and Paint Sludge	25	30	11	5	15	11	NA	NA	NA
Resins, Latex, and Monomer	25	30	11	5	15	11	NA	NA	NA
Metallic Dusts and Shavings	25	20	NA	5	10	NA	NA	NA	NA
Nonmetallic Inorganic Dusts	25	20	NA	5	10	NA	NA	NA	NA
Halogenated Organic Solids	25	30	11	5	15	11	NA	NA	NA
Nonhalogenated Organic Solids	25	20	11	5	10	11	NA	NA	NA
Pesticides, Herbicides	25	30	11	5	15	11	NA	NA	NA
Polychlorinated Biphenols, PCBs	25	60	NA	5	60	NA	NA	NA	NA
Explosives	25	20	11	5	10	11	NA	NA	NA

(Continued)

SOURCE: Congressional Budget Office.

NOTE: NA = Not Applicable.

a. Treatment residuals placed in land disposal facilities and any wastes placed in sanitary landfills are taxed at $25 per one metric ton (MT).

b. Wastes transported off-site are taxed at rates 20 percent higher than shown. Land-treated wastes are taxed at one-half the rates shown for Land Disposal No Treatment. Long-term storage of PCB's would be taxed at $60 per MT.

TABLE 20. Continued

Waste Type	Incineration			Recycle/ Reuse Material Recovery			Long-Term Storage		
	1	2	3	1	2	3	1	2	3
Waste Oils	0	2	NA	0	0	NA	25	0	NA
Halogenated Solvents	0	2	3	0	0	3	25	0	3
Nonhalogenated Solvents	0	2	3	0	0	3	25	0	3
Other Organic Liquids	0	1	3	0	0	3	25	0	3
Metal-Containing Liquids	NA	NA	3	0	0	3	25	0	3
Cyanide and Metal Liquids	NA	NA	3	0	0	3	25	0	3
Nonmetallic Inorganic Liquids	NA	NA	3	0	0	3	25	0	3
Oily Sludge	0	4	3	0	0	3	25	0	3
Halogenated Organic Sludge	0	8	3	0	0	3	25	0	3
Nonhalogenated Organic Sludge	0	4	3	0	0	3	25	0	3
Metal-Containing Sludge	NA	NA	3	0	0	3	25	0	3
Cyanide and Metal Sludge	NA	NA	3	0	0	3	25	0	3
Nonmetallic Inorganic Sludge	NA	NA	3	0	0	3	25	0	3
Contaminated Clay, Soil, Sand	NA	NA	3	0	0	3	25	0	3
Dye and Paint Sludge	NA	NA	3	0	0	3	25	0	3
Resins, Latex, and Monomer	NA	NA	3	0	0	3	25	0	3
Metallic Dusts and Shavings	NA	NA	NA	0	0	NA	25	0	NA
Nonmetallic Inorganic Dusts	NA	NA	NA	0	0	NA	25	0	NA
Halogenated Organic Solids	NA	NA	3	0	0	3	25	0	3
Nonhalogenated Organic Solids	NA	NA	3	0	0	3	25	0	3
Pesticides, Herbicides	NA	NA	3	0	0	3	25	0	3
Polychlorinated Biphenols, PCBs	NA	NA	NA	0	0	NA	25	60	NA
Explosives	NA	NA	3	0	0	3	25	0	3

c. Wastes disposed in landfills, surface impoundments, waste piles, and land treatment units would be taxed at the higher of two rates; waste exported, disposed of into or on the ocean or managed in any other form at a RCRA Subtitle C facility would be taxed at the lower rate. Rates presented in the table are rounded; actual values used in model calculations were $10.78 per metric ton (high rate) and $2.87 (low rate). Year two through year five graduations are detailed in Congressional Record, p. S1833 (February 22, 1985). Year five rates used were $17.95 per metric ton (high rate) and $4.81 (low rate).

less expensive) management technologies. [8] Thus, taxes would be highest ($25.00 per metric ton) for untreated wastes placed in landfills or surface impoundments and for use of any other long-term storage facility, while rates are reduced for each of the following methods: land-treatment ($5.00 per metric ton), stabilization ($5.00 per metric ton), and injection wells ($4.00 per metric ton). No taxes would be levied against wastes that are incinerated, recycled, or reused.

For methods that combine both treatment and disposal processes, waste residuals would be taxed at the applicable rate for the disposal method. For example, incineration itself would not be taxed, but hazardous incinerator ashes placed in a landfill would be taxed. Finally, the highest tax rate would be applied to long-term waste storage to discourage generators from storing waste, instead of properly treating and disposing of it in a timely fashion.

Tax System 2: Discourage Certain Hazardous Waste and Disposal Combinations. Tax System 2 is graduated on the basis of waste hazard, management technique, and place of disposal (on-site versus off-site). It levies the highest taxes on pairings of certain wastes with certain management processes that create the greatest hazard to health and the environment. The ranking of potential hazard is based on the "high priority" wastes identified by the Congress as inappropriate for land disposal in the 1984 RCRA amendments (see Chapter III). Hazard potential is further ranked by waste phase. Because of their greater likelihood to migrate from the disposal zone, liquid wastes would be taxed at a higher rate than more stable solid wastes. Finally, waste-technology pairings would be taxed an additional 20 percent if sent to an off-site facility, to reflect the added potential risks posed by transporting the wastes. [9]

Under Tax System 2, the highest rates ($60 per metric ton) would be set for liquids with high-priority constituents. These include metal cyanides, heavy metals, halogenated organics, PCBs, and caustic acids and bases (see Table 20). Taxes on land disposal of waste oil also would be high to promote desirable management options, such as recycling. Taxes would be lower ($20 to $30 per metric ton) for untreated sludges, unless they also contain high-priority constituents. Relatively inert, solid substances, such as metallic and nonmetallic dusts, would be taxed the least ($20 per metric ton). Pretreatment to reduce toxicity or stabilization to reduce the mobility of toxic constituents before land disposal would earn many waste types a significant reduction in tax rates. Incineration of wastes would lower taxes dramatically, especially for liquids.

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[8] Variable tax rates were devised, by waste, through the CBO cost accounting model described in Chapter II.

[9] See, for example, Mark Abkowitz, *Assessing the Releases and Costs Associated With Truck Transport of Hazardous Wastes* (prepared for the Environmental Protection Agency, Office of Solid Waste, by ICF, Inc., Draft Final Report, January 1984).

Tax System 3: Assuring Revenue Stability. Tax System 3 is the Administration's proposed waste-end tax system, introduced as S. 494 in the 99th Congress. As stated in the proposal, the tax structure is designed "to provide a stable and predictable source of revenue [for Superfund]; to broaden the tax base from which contributions are received; to minimize adverse economic impacts on taxed industries; and to focus the tax on the types of industries and [waste management] practices that have caused the problems that are addressed by Superfund." 10/

The Administration's proposal is similar to Tax System 1 in that it would distinguish tax levels only on the basis of waste management method and would seek to discourage the use of landfills and surface impoundments. Landfills, surface impoundments, waste piles, and land treatment units would be taxed at the highest rate of $10.78 per metric ton in year one. All other waste management methods, including waste exportation to other countries or disposal into or over the ocean, would be taxed at the lower rate of $2.87 per metric ton in year one. Tax System 3 differs from Tax System 1, however, by increasing tax rates each year to maintain more stable revenues over time, despite a declining tax base. (Tax-induced shifts by industry away from the highest taxed technologies would tend to reduce the overall tax base.)

Tax System 3 also would yield lower revenues than either Tax Systems 1 or 2. First, tax rates under the Administration proposal would be considerably lower for most technologies, even in year five of the tax. Second, by not taxing certain non-RCRA wastes streams now sent primarily to sanitary landfills (which are included in the CBO waste coverage and taxed by Tax Systems 1 and 2), Tax System 3 would use a much smaller tax base.

Tax System 3 also could be expected to yield somewhat less dramatic waste management shifts than Tax Systems 1 and 2, by virtue of its small tax differential between undesirable technologies, such as landfills (taxed at $10.78 per ton in year one) and presumably more desirable technologies,

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10. See Congressional Record (February 22, 1985), p. S1833.

such as incineration of wastes at sea (taxed at $2.87 per ton). Tax differentials in Tax Systems 1 and 2 were set higher in many cases, because CBO found an $8 per ton tax difference too small to erode the cost advantage currently held by landfills over more advanced technologies. The EPA notes, however, that because the tax would be imposed in addition to the new regulatory incentives required by the 1984 RCRA amendments, Tax System 3 should still induce significant waste management changes. Results presented in Table 21 support this assertion.

Tax System 4: A Flat Tax on Waste Generation. Tax System 4 (not depicted in Tables 20 and 21) imposes a flat tax of $5 on each metric ton of hazardous waste generated. By making no distinction among waste or disposal types, however, a small flat tax would encourage little change in management practice and provide fewer incentives for waste reduction than Tax Systems 1, 2, or 3. While higher flat tax rates would increase industrial incentives to undertake waste reduction efforts, they still would not selectively discourage production of the most hazardous waste types or use of the most risky disposal methods. Superfund revenue generation and administrative simplicity are therefore the primary benefits of Tax System 4.

Effects of Tax Systems on Waste Generation and Management

By significantly changing the relative costs of available treatment and disposal options, Tax Systems 1 and 2 should induce waste management shifts and lower the total amount of waste generated to levels about equal to those projected under the new law's most favorable implementation conditions (see Table 21). Tax System 3 also is expected to encourage industry to meet its maximum waste reduction potential. But the directions of certain waste management shifts should differ from Tax Systems 1 and 2 because the Administration's proposal would not tax certain wastes or waste management practices (such as non-RCRA wastes entering sanitary landfills). [11] Tax System 4 (the flat tax) would encourage waste reduction efforts and management shifts only in industries with dilute, high volume waste streams; the low tax rate would not affect management of harder-to-treat wastes.

The effect of the first three tax systems can be viewed in terms of first-year effects (1986 in this analysis) and after five years. Tax System 4 is not considered because the flat tax does not change relative costs among

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[11] All estimates of waste management shifts and revenue potential for the Administration's proposal are based on the CBO model, using CBO's assumptions regarding current waste generation and management.

TABLE 21. WASTE MANAGEMENT SHIFTS UNDER TAX SYSTEMS 1, 2 AND 3 (In millions of metric tons)

Technology	1983	1990 Under 1984 Law		1986			1990		
	Quantity Managed	Without Waste Reduction	With Waste Reduction	Tax System 1 [a]	Tax System 2 [a]	Tax System 3 [a]	Tax System 1 [a]	Tax System 2 [a]	Tax System 3 [a]
Injection Well	66.8	50.7	41.6	62.7	61.2	64.8	39.0	33.4	35.5
Hazardous Waste Landfill									
No pretreatment	34.2	22.2	22.2	25.6	20.5	27.9	22.2	17.6	23.7
With stabilization	b	70.7	66.1	2.6	1.8	1.8	27.2	40.5	14.0
Surface Impoundment	49.5	11.2	10.8	25.6	46.6	33.9	10.7	10.7	10.7
Incineration	2.7	11.6	8.2	2.7	2.7	2.7	8.2	8.2	2.7
With stabilization of residue	b	b	b	b	b	b	b	b	b
Sanitary Landfill	26.7	11.3	10.7	25.6	27.3	27.6	10.7	10.7	27.6
Oxidation	3.0	7.6	5.2	3.7	3.9	3.8	6.3	7.4	4.8
Land Treatment	2.9	5.7	4.8	3.6	4.1	3.2	1.0	12.6	0.7
Industrial Boilers	9.5	12.1	9.0	10.1	11.8	9.8	11.6	9.5	9.1
Distillation	10.9[c]	11.0[c]	9.5[c]	11.9[c]	11.9[c]	11.9[c]	11.9[c]	11.9[c]	11.9[c]
Ion Exchange	0.5	0.9	0.5	3.0	3.3	3.2	12.4	13.4	3.8
Solvent Extraction	b	0.9	0.9	b	b	b	b	b	b
Electrodialysis	b	b	b	1.9	1.9	1.9	9.2	9.2	2.8
Oil Rerefining	1.8[d]	2.8	2.4	1.8	1.8	1.2	3.0	1.7	2.8
Metal Recovery	b	1.2	0.5	1.1	1.1	1.1	5.4	5.4	4.7
Long-Term Storage	b	b	b	0.9	b	1.4	1.7	0.8	3.0
Sewers and Direct Discharge[e]	58.9	60.9	36.7	66.9	49.8	53.5	48.6	36.1	71.3
Total	265.6	280.8	229.1	249.7	249.7	249.7	229.1	229.1	229.1

SOURCE: Congressional Budget Office.

a. Tax rates detailed in Table 20. Waste management shifts induced by the new cost structure created by the tax rate are limited to 20 percent of eligible wastes per year. Actual shifts may be higher or lower, depending on factors such as equipment availability.

b. Less than 0.5 million metric tons.

c. Reflects recycling of lower grade solvents.

d. EPA's Office of Solid Waste believes the current figure for oil rerefining to be about 0.3 MMT, and expects this to increase to about 0.8 MMT by 1990.

e. Wastes entering this category are treated residuals from other treatment and disposal processes or wastes disposed in compliance with Clean Water Act regulations, and should pose relatively little threat to the environment.

technologies and thus would not effect waste management shifts. In 1986 all tax systems would begin to encourage the move away from hazardous waste landfills without pretreatment, hastening changes eventually required by the 1984 RCRA amendments. For example, untreated waste sent to landfills would fall from 34.2 million metric tons in 1983 to 25.6 MMT in 1986 under Tax System 1, to 20.5 MMT under Tax System 2, and to 27.9 MMT under Tax System 3. By 1990 landfilled waste without pretreatment would fall even further, as all three tax systems would encourage greater use of advanced treatment techniques, such as ion exchange, metal recovery, electrodialysis, and waste stabilization before landfilling. Tax Systems 1 and 2, for example, should increase the use of these four technologies from less than 1 million metric tons in 1983 to between 54 MMT and 69 MMT by 1990. Tax System 3 should also promote these four treatment types significantly, to over 25 MMT by 1990. This somewhat lower value is accounted for largely by a smaller increase in waste stabilization under Tax System 3, because of the absence of any tax to discourage the use of sanitary landfills.

In general, the direction of management shifts under all three tax systems would be similar to those projected under full implementation of the new law, but would tend to encourage shifts earlier than might occur under the RCRA regulatory timetable presented in Table 9 in Chapter III. Thus, waste-end taxes could work well to stimulate changes in waste management practice to support impending prohibitions and requirements of the 1984 RCRA amendments.

Expected Revenues

Besides their ability to induce desired waste management changes, waste-end taxes would provide revenues to the government. The revenues could be employed to finance Superfund cleanups or ongoing hazardous waste management efforts, such as state grants and increased enforcement efforts. Tax System 1 would raise an estimated $2.7 billion in its first year, declining to about $1.3 billion in the fifth year (see Table 22.) A similar drop in revenues for this period would occur under Tax System 2, from $2.4 billion in year one to about $1.6 billion in year five. Tax System 3 could yield about $1.1 billion in year one, falling to about $500 million by year five. Tax System 4 could generate about $1.4 billion in revenues in year one, declining to slightly over $1 billion in revenues by 1990. The drop in tax revenues--particularly for Tax Systems 1, 2, and 3--would occur as industries reduced the amount of wastes generated or switched to disposal technologies that have lower taxes. This decline in revenues indicates that the waste tax systems have functioned effectively.

TABLE 22. ANNUAL REVENUES FROM ALTERNATIVE TAX SYSTEMS (In millions of 1983 dollars)

	Tax System 1: Technology Basis		Tax System 2: Waste Hazard Basis		Tax System 3: Administration Proposal		Tax System 4: Flat Tax	
Year	With Waste Reduction [a]	Without Waste Reduction [b]	With Waste Reduction [a]	Without Waste Reduction [b]	With Waste Reduction [a]	Without Waste Reduction [b]	With Waste Reduction [a]	Without Waste Reduction [b]
1	2,744	2,744	2,356	2,356	1,143	1,143	1,358	1,358
2	2,252	2,413	2,175	2,236	840	893	1,308	1,369
3	1,881	2,083	1,985	2,116	605	692	1,257	1,380
4	1,607	1,753	1,815	1,994	534	601	1,205	1,391
5	1,278	1,422	1,631	1,878	468	544	1,153	1,402

SOURCE: Congressional Budget Office.

a. Waste generation based on projections in Table 13.

b. Waste reduction assumed, based on quantities identified in Table 13.

CBO's estimates of Tax System 3 revenues differ from those made by the EPA, which projected revenues of $600 million per year over several years. These different estimates result primarily from assumptions about the size of the potential tax base. Because CBO includes more wastes that are currently managed in high-tax categories like land disposal than does EPA, CBO's year one revenue estimates are higher. 12/

In all three tax systems, large projected shifts from high-tax disposal methods to lower-tax categories would cause a decline in the size of the tax base in subsequent years. The declining base would reduce tax revenues gradually in years two through five, rather than maintain a single stable revenue level, as projected by EPA for Tax System 3. Actual revenues realized by the federal government would also be lower if firms were permitted to deduct their waste tax costs from taxable income. Therefore, Tax Systems 1, 2, and 3 would serve as less stable Superfund revenue sources than flat waste-end or feedstock taxes.

Cost to Industry

Short-term costs to industry would likely increase under the waste-end tax systems. If the tax structures were implemented today, first-year incremental costs to industry would be about $1.1 billion to $2.7 billion (see Table 23), declining to between $500 million and $1.9 billion in 1990. The cost to industry of waste-end taxes measured as a percent of expected profit would be significant in some cases, but not that much greater than the eventual projected effects of the 1984 RCRA amendments without any additional tax system (see Table 24). The effects shown in Table 24 assume that industry has not responded to economic incentives to reduce waste production. In such an instance, the institution of any of the four tax systems would increase the expected maximum expenditures for hazardous waste management to as much as 30 percent over those otherwise expected in 1990 as a result of the 1984 RCRA amendments.

Table 25 depicts the more likely case for 1990, in which the combined effect of the 1984 amendments and waste-end taxes induce industries to achieve their full waste reduction potential. The results of Table 25 show that for all industries, 1990 expenditure-to-profit ratios would be signifi-

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12. The EPA's own estimates of revenue potential and management shifts were calculated by the Office of Policy Analysis model, assuming a different size tax base. See EPA, *The Feasibility and Desirability of Alternative Tax Systems for Superfund*, Section 301(a)(1)(G) study (December 1984).

cantly lower than those presented in Table 24, because of waste reduction effects in the 1985 to 1990 period.

Tables 24 and 25 indicate that the relative costs borne by major industry groups primarily result from whether or not waste reduction is instituted. The relative costs among industries under either response case are similar. In general, the economics of individual industries or firms would be affected to various degrees, depending on their waste reduction potential, waste flows, and size. Firms that could switch quickly to new technologies to avoid taxes would reduce their overall incremental compliance burden for the 1985 through 1990 period, because prices for new technologies probably will increase sharply in the short term. On the other hand, some firms

TABLE 23. YEAR ONE TAX COSTS UNDER ALTERNATIVE TAX SYSTEMS, BY MAJOR INDUSTRY GROUP (In millions of 1983 dollars)[a]

Major Industry	Tax System 1[b]	Tax System 2[b]	Tax System 3[c]	Tax System 4[d]
Chemicals and Allied Products	1,218.7	1,270.6	585.1	655.4
Primary Metals	644.3	296.1	225.3	244.1
Petroleum and Coal Products	313.4	255.5	136.8	150.7
Rubber and Plastic Products	207.7	229.0	71.5	79.5
Fabricated Metal Products	181.7	168.1	53.6	127.1
Nonelectrical Machinery	65.8	27.2	26.9	26.1
Miscellaneous Manufacturing	41.9	51.3	16.2	28.6
Transportation Equipment	30.6	33.8	13.0	15.4
Electrical and Electronic Machinery	19.1	16.4	5.0	10.4
Motor Freight Transportation	11.7	3.1	3.8	10.8
Wood Preserving	8.8	4.9	5.9	9.4
Drum Reconditioners	0.3	0.3	0.1	0.2
Total	2,744.0	2,356.3	1,143.2	1,357.7

SOURCE: Congressional Budget Office.

a. Assumes tax begins in 1986; no waste reduction assumed in year one of the tax.

b. Based on CBO tax schedule in Table 20.

c. Based on Administration's proposal shown in Table 20.

d. Based on flat tax of $5.00 per metric ton of hazardous waste.

TABLE 24. HAZARDOUS WASTE MANAGEMENT EXPENDITURES AS A PERCENT OF EXPECTED PROFITS, NO WASTE REDUCTION CASE, 1990 [a] (In percents)

	1990 Under New Law [b]	1990 Under New Law and Tax System 1 [b]	1990 Under New Law and Tax System 2 [b]	1990 Under New Law and Tax System 3 [b]	1990 Under New Law and Tax System 4 [b]
Wood Preserving	111.0	134.7	122.4	129.0	143.6
Primary Metals	64.2	94.9	97.9	77.8	79.2
Rubber and Plastic Products	52.3	55.3	59.8	55.0	56.1
Chemicals and Allied Products	44.6	59.4	64.4	61.0	63.9
Petroleum and Coal Products	33.8	39.4	37.8	39.5	39.9
Fabricated Metal Products	28.1	32.0	43.3	33.0	40.2
Miscellaneous Manufacturing	8.7	10.0	11.2	10.3	11.5
Electrical and Electronic Machinery	3.2	3.5	4.1	3.4	3.7
Transportation Equipment	2.9	3.1	3.8	3.2	3.2
Nonelectrical Machinery	1.9	4.4	4.2	2.6	2.6
Drum Reconditioners	c	c	c	c	c
Motor Freight Transportation	d	d	d	d	d

SOURCE: Congressional Budget Office, based in part on profit to sales ratios found in Dun and Bradstreet, *Industry Ratios and Financial Norms* (1983-1984 edition).

a. The expenditure burdens displayed in the table represent the amount of industry profits that would have to be devoted to hazardous waste management and waste taxes, all other things being equal. In fact, industries might be able to pass along these added costs to customers and avoid profit reductions. Since this ability would vary with firms and markets, the figures displayed here give only a rough idea of relative burdens under the various waste management options.

b. Assumes no waste reduction. Each case therefore represents the highest potential burden to be borne by industry in 1990.

c. Less than 1 percent.

d. Profit data not available.

TABLE 25. HAZARDOUS WASTE MANAGEMENT EXPENDITURES AS A PERCENT OF EXPECTED PROFITS, WASTE REDUCTION CASE, 1990[a] (In percents)

	1990 Under New Law[b]	1990 Under New Law and Tax System 1[b]	1990 Under New Law and Tax System 2[b]	1990 Under New Law and Tax System 3[b]	1990 Under New Law and Tax System 4[b]
Wood Preserving	15.6	40.3	27.0	33.6	38.2
Primary Metals	25.3	56.0	59.0	38.9	40.3
Rubber and Plastic Products	41.4	44.4	48.9	44.1	45.2
Chemicals and Allied Products	20.9	35.7	40.7	37.3	40.2
Petroleum and Coal Products	20.9	26.5	24.9	26.6	27.0
Fabricated Metal Products	c	4.0	15.2	5.0	12.1
Miscellaneous Manufacturing	4.0	5.3	6.5	5.6	6.8
Electrical and Electronic Machinery	c	0.3	0.9	0.2	0.5
Transportation Equipment	1.6	1.8	2.5	1.9	1.9
Nonelectrical Machinery	1.0	3.5	3.3	1.7	1.7
Drum Reconditioners	c	c	c	c	c
Motor Freight Transportation	d	d	d	d	d

SOURCE: Congressional Budget Office, based in part on profit to sales ratios found in Dun and Bradstreet, *Industry Ratios and Financial Norms* (1983-1984 edition).

a. The expenditure burdens displayed in the table represent the amount of industry profits that would have to be devoted to hazardous waste management and waste taxes, all other things being equal. In fact, industries might be able to pass along these added costs to customers and avoid profit reductions. Since this ability would vary with firms and markets, the figures displayed here give only a rough idea of relative burdens under the various waste management options.

b. Assumes full waste reduction. Each case therefore represents a low estimate of potential burden to be borne by industry in 1990. Certain firms or industries may potentially exceed CBO's waste reduction targets (see Table 11) and lower expenditures further.

c. Less than 1 percent.

d. Profit data not available.

wishing to switch to low-tax technologies, but unable to because of off-site capacity shortages, could incur higher compliance costs by being forced to dispose of their wastes with a high-tax technology, such as a landfill.

Individual industry costs also would vary by the types and characteristics of waste generated. Certain primary metals and electroplating firms that generate large quantities of inorganic substances, such as metal sludges, might have limited alternatives to placing such wastes in landfills. These firms could be forced to pay high taxes until alternative treatment or disposal techniques can be developed. In addition, the tax systems would tax all wastes on a "wet-basis," 13/ making no distinction between what portion of the waste is water and what is actually the regulated waste. Therefore, many firms that generate substantial volumes of dilute, aqueous wastes would be penalized with large tax liabilities, even though their waste streams might be low in relative hazard on a per unit of waste basis. On the other hand, such firms also would possess a strong incentive to reduce their waste flows in some manner.

The costs for individual firms would also depend on firm size. Small quantity generators would be at a significant disadvantage relative to larger generators in the same industry under the alternative tax systems for two reasons. First, larger firms might be in a better position to pass on taxes as price increases. Their size alone generally gives larger producers a unit cost advantage. Larger producers often can also pass on taxes over a much larger product base. Thus, waste-end taxes would increase prices of products less for larger producers than they would for small producers. In one recent study, for example, it was estimated that passing forward all costs of treating metal-containing wastes would increase the average prices of electroplating piecework by 2 percent to 13 percent for larger plants (20 employees or more); but for small plants (1 to 19 employees), it would increase prices by 26 percent to 98 percent. 14/

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13. In practice, waste streams are commonly identified on a volume basis, rather than by the nonwater weight or solid content of the waste streams. Taxing on a dry-weight basis would therefore create additional measurement and tax administration difficulties, such as the need for individual waste stream testing to determine the proper tax rates to employ in each case. See Pope-Reid Associates, *Effects of Changing the CERCLA Tax Basis* (prepared for EPA Office of Policy Analysis, December 1983); and Joint Committee on Taxation, *Background and Issues Relating to the Reauthorization and Financing of the Superfund*, Staff Report (April 24, 1985).

14. Pope-Reid Associates, Inc., *Economic Impact Analysis of a Landfill Ban and a Waste-End Tax for the Electroplating Industry* (February 1984).

Second, smaller firms generally have greater constraints on capital formation. Without the financial capacity to install the waste reduction or pollution control equipment necessary to lower waste taxes, many small generators would have to pay high tax rates or even go out of business. By deliberately increasing the tax on off-site waste treatment--20 percent above those for identical on-site treatment methods--to account for the risks of transportation, Tax System 2 would particularly strain small generators' resources. Options that could improve small generators' access to capital might therefore be desirable.

Administrative Issues

Waste-end taxes are usually aimed at the most hazardous waste types and disposal methods to promote waste reduction efforts and the use of the most appropriate disposal technologies. These goals should be balanced, however, with the need for administrative simplicity, since complex tax systems risk widespread tax evasion. 15/ The most desirable hazard-based tax system thus would be the most difficult to devise and administer.

Ease of Assessment. A primary administrative concern is the ease with which waste-end taxes could be assessed. The simplest tax system to administer would have a small number of known potential collection points. On this basis, Tax System 3 appears to be the most desirable. Taxes would be collected at the estimated 5,000 treatment, storage, and disposal (TSD) facilities that now possess interim permits to operate under RCRA. It is unclear, however, exactly how generators that export their wastes to other countries would be assessed under Tax System 3.

The next simplest to assess would be Tax System 1, which would tax the 5,000 TSD facilities assessed under Tax System 3, plus sanitary landfills receiving potentially hazardous waste. Uncertainty about the exact number and location of such facilities accounts for the greater complexity of Tax System 1.

Tax System 4 (the flat tax) would be the third easiest to administer on these grounds. It would assess taxes at an estimated 140,000 points of collection--the sources of waste generation.

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15. See, for example, Testimony of Howard J. Hoffman on Superfund Expansion and Protection Act of 1984 (H.R. 5640), before the House Committee on Ways and Means (July 15, 1984).

Finally, Tax System 2 would probably be the most difficult to institute because of its hazard-based approach. Although Tax System 2 would have only 5,000 collection points (at treatment, storage, and disposal points), each waste batch would potentially require sampling to determine its proper tax. The EPA also would need to revise its current waste coding system, which would require a full rulemaking process. For these reasons, a hazard-based tax scheme of this type appears to be the most complex of the four options studied.

Incentives for Improper Management. A second administrative issue concerns a tax system's potential incentives for improper waste management. If a tax system provides enough incentives to reduce waste generation or to begin recycling wastes, it also might provide enough incentives to lower or avoid taxes by legal or illegal means. These methods include the exporting of wastes to other countries for potentially illegal disposal; increased waste storage (not taxed under Tax System 2) to avoid taxation; and illegal, unreported dumping. These incentives for noncompliance might be strongest for high-hazard, hard-to-treat wastes.

While tax systems could be adjusted to discourage waste exporting or storage, preventing tax evasion would be more difficult. As with the current regulatory system (which also raises industry's costs of compliance and thus provides cost incentives for noncompliance), vigorous enforcement might deter illegal disposal. But increasing enforcement efforts would be quite expensive for federal and state governments. An alternative would be to assess taxes on all firms automatically, based on existing knowledge of the types and quantities of waste produced by different industries. 16/ Firms that disputed the government's waste-tax assessment would be allowed to demonstrate that they had generated less waste than projected and therefore could receive a tax refund. Such an approach could potentially lower the enforcement burden to government. Complete "model plant" information could be developed by the EPA if increased reporting requirements were implemented. 17/

Revenue Shortfalls. Another important administrative concern is possible revenue shortfalls, especially if waste-end tax revenues were the sole fund-

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16. Germany uses this type of model plant analysis to assess water taxes. See Blair T. Bower and others, *Incentives in Water Quality Management in France and the Ruhr Area* (Washington, D.C.: Resources for the Future, 1981).

17. As an example, biennial reporting requirements contained in S. 51 (Hazardous Substance Inventory) could be used. This legislation was approved by the Senate Committee on Environment and Public Works on March 3, 1985.

ing source for an expanded Superfund cleanup program. [18] Revenue shortfalls could occur--and have in some states--if tax bases or rates were poorly defined in statutes or if projections failed to account for unexpected drops in industrial activity, nonreporting of waste, or uncertainties about the initial size of the potential tax base. Tax rates could be adjusted periodically to ensure adequate revenues to cover the federal expenses of administering the program. For example, the Administration has proposed adjusting the graduated tax rates annually, under Tax System 3, to compensate for any unanticipated revenue shortfalls.

Planned annual increases in tax rates could also ensure somewhat more stable revenue levels, without creating as much uncertainty for corporate taxpayers as would annual adjustments of unknown amounts. As proposed by the Administration, Tax System 3 would be graduated upwards annually to promote revenue stability. The CBO results, however, disagree with EPA's claim that the proposed tax structure would provide a stable revenue source for five years (see Table 22). The flat tax of Tax System 4 was found to provide the most stable source of revenues, because revenues under this system fell the least (about 15 percent) of the four tax alternatives (see Table 22).

Gradually increasing taxes under Tax Systems 1 and 2 could stabilize the decline in revenues illustrated in Table 22. The CBO found that Tax System 1 would provide a stable source of revenue if a 20 percent annual tax increase was imposed for five years. With this adjustment, year-five revenues would decline only 14 percent from year-one revenues for Tax System 1, compared with 31 percent for Tax System 2. A yearly 20 percent increase in tax costs would probably have dramatically adverse effects in some industries, however.

State Waste-End Taxes. Finally, a federal waste-end tax might need to be coordinated with those imposed by states. In 1984 20 states collected waste-end taxes from hazardous waste generators (see Table 26). Together, these states account for 52 percent of all hazardous wastes generated in the nation. If the average state tax rate was half the highest rate in Table 26, then only about $10 a metric ton would be collected on average. A federal tax could be superimposed on existing state tax systems, with credits provided to generators already paying state taxes. The loss to the federal government, assuming no new state waste taxes, would be about 10 percent

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[18] Revenue shortfalls should not be confused with the declining revenues that come from the success of a waste-end tax in promoting waste reduction efforts, which, in turn, lead to tax-base erosion.

TABLE 26. STATE WASTE-END TAX SYSTEMS IN 1984

State	Treated Wastes Taxed	Higher Rate for Off-site Management	Who Pays	Highest Possible Tax Rate (In dollars per ton)
Alabama	Yes	Yes	Generator and facility operator	10.00
California	Yes	No	Generator and facility operator	45.66
Colorado	Yes	No	Facility operator	2.00
Connecticut	Yes	Yes	Generator	10.00
Illinois	Yes	Yes	Facility operator	6.60
Indiana	No	No	Facility operator	1.50
Iowa	Yes	Yes	Facility operator	50.00
Kansas	Yes	Yes	Generator and facility operator	5.00
Kentucky	Yes	Yes	Generator	11.00
Louisiana	Yes	Yes	Facility operator	10.00
Maine	Yes	Yes	Facility operator	33.00
Minnesota	Yes	No	Generator	70.40
Mississippi	No	Yes	Facility operator	9.00
Missouri	Yes	No	Generator and facility operator	26.00
New Hampshire	Yes	Yes	Generator	36.60
New York	Yes	Yes	Generator	12.00
Ohio	No	Yes	Facility operator	8.99
South Carolina	No	No	Facility operator	7.00
Tennessee	No	Yes	Generator	7.00
Wisconsin	No	No	Facility operator	0.14

SOURCE: Congressional Budget Office from Office of Technology Assessment, Statement of Joel S. Hirschhorn for the Hearing Record, Senate Committee on Environment and Public Works, 98:2 (September 10, 1984).

of the revenue that would be collected in the absence of state taxes. The principal purpose of a waste-end tax is the promotion of waste reduction, however, not revenue collection. Moreover, the revenue received by states from waste-end taxes could directly benefit state-run hazardous waste programs.

REVENUE OPTIONS FOR THE SUPERFUND PROGRAM

The primary purpose of the current feedstock tax under Superfund is to pay for the cleanup of abandoned hazardous waste sites. Authorization for Superfund expires at the end of September 1985, with only a few of the approximately 800 priority sites fully restored. If current cleanup goals are continued, the EPA projects that the priority list will eventually total 1,400 to 2,200 sites. The Office of Technology Assessment believes that the number of priority sites could climb as high as 10,000. The EPA estimates the costs of future cleanups will range from $10 billion to $33 billion, and others have projected still higher amounts. 19/ Accelerated and complete cleanup of all potentially hazardous Superfund sites, therefore, would entail an expanded program. A major factor limiting annual spending ceilings is the speed with which the EPA can disburse funds and clean up sites each year. Recent EPA and OTA analyses estimate that this ceiling is between $1 billion to $1.2 billion per year. 20/ Several alternative funding sources exist for meeting these revenue needs, including:

- Institution of a waste-end tax,
- Increases in the current feedstock tax,
- Cost recovery from responsible parties through litigation and settlements,
- Voluntary contributions,
- Institution of a corporate receipts tax, and
- General revenues.

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19. The Office of Technology Assessment estimates that cleanup costs of as many as 10,000 sites could reach $100 billion. See OTA, *Superfund Strategy* (1985).

20. OTA, Statement of Joel S. Hirschhorn for the Hearing Record, Senate Committee on Environment and Public Works, 98:2, (September 10, 1984).

A combination of these measures could raise as much as $1.1 billion to $3.2 billion in the first year (see Table 27). Because the growing number of priority cleanup sites could require financial resources beyond those reasonably available under either a feedstock tax or a waste-end tax, a well-timed combination of these and the other revenue alternatives could provide the needed resources for an expanded Superfund program. A combination would be needed because no one revenue source could satisfactorily meet the primary objectives of an effective Superfund tax: adequate and stable revenues over a decade or more, creation of hazardous waste management incentives to help prevent new uncontrolled sites from emerging in the future, and recovery of costs from those parties actually responsible for Superfund sites. For example, while waste-end taxes would provide strong incentives

TABLE 27. POTENTIAL REVENUE SOURCES FOR SUPERFUND
(In millions of 1983 dollars)

Revenue Source	Year One	Year Five	Year Ten
Waste-End Tax [a]	600-2,700	500-1,300	400
Feedstock Tax [b]	250	250	250
Cost Recovery [c]	25	100	100
Voluntary Contributions [d]	40	40	40
Corporate Receipts Tax [e]	100	500	500
General Revenues [f]	44	44	44
Total	1,059-3,159	1,434-2,234	1,334

SOURCE: Congressional Budget Office and Congressional Record, p. S1833 (February 22, 1985).

a. Receipts in year ten might be lower if industries devise advanced waste reduction measures. Range based on Tax Systems 1, 2, 3, and 4.

b. Assumes continuation of current tax rates.

c. Based on CBC baseline budget assumptions.

d. Reflects projected equivalent value of voluntary cleanups that Superfund would not have to fund.

e. Year one tax rate of .0055 percent; year five and year ten tax rate of .0275 percent (see Table 28).

f. Assumes general revenue contribution is held at current levels.

for waste reduction that presumably would reduce the creation of new Superfund sites, the reduction in waste output, in turn, would lead to declining revenues over time. Waste-end taxes also might penalize waste producers who did not mismanage wastes in the past. On the other hand, broad-based revenue sources that spread the cost of waste cleanup over all taxpayers--such as the use of general revenues--would not provide any incentives for improved waste management. The revenue alternatives are discussed below.

Waste-End Taxes

Imposition of some form of waste-end tax would provide a significant source of Superfund revenues for several years. Tax Systems 1, 2, or 3 would also provide the added benefit of stimulating industrial waste reduction measures, which presumably could reduce the dimensions of the site cleanup program in the future. Because waste reduction efforts would erode the tax base quickly, however, waste-end taxes would not provide as stable a revenue source as would the current feedstock tax--although they could provide as much as ten times the revenue for a short period. After firms adjust to waste-end taxes, revenues would be more stable, but lower.

On the other hand, a small, flat waste-end tax (Tax System 4) would raise revenues without stimulating significant waste management shifts or providing incentives for waste reduction (except for generators of high volume, dilute aqueous hazardous waste streams). If instituted in 1986, a $5.00 per metric ton tax could generate about $1.36 billion in revenues in that year. This tax would still raise slightly over $1 billion by 1990, even if industries achieved their maximum waste reduction potential. Changes in the amount of regulated (and taxed) waste could affect these revenue estimates significantly, however. [21]

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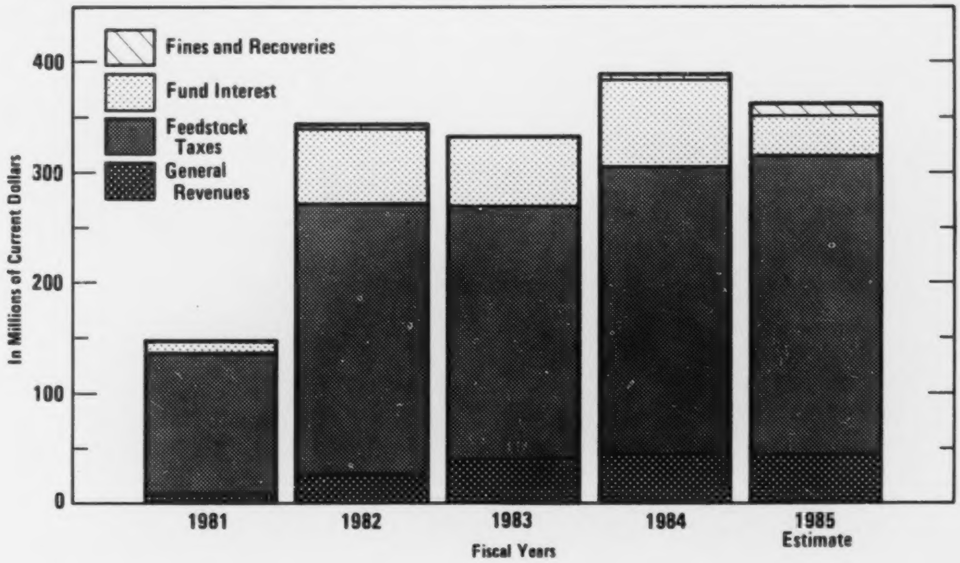
[21] Others have suggested that additional revenues could be raised by taxing potentially hazardous emissions permitted under other federal environmental legislation, such as hazardous substances regulated by Section 112 of the Clean Air Act and Section 311(b)(2)(A) of the Clean Water Act. It is difficult to predict accurately the revenues that could be raised in this manner, however, because only limited data is now available on the actual quantities of emissions. (Perhaps as little as 50,000 metric tons of toxic air pollutants and 78,000 metric tons of toxic organics and metals in solution are currently released each year.) The hazardous substance inventory proposed under S. 51 would require industries to report on air and water emissions for the first time on a regular basis. Data from these reports could probably improve the reliability of revenue estimates for such expanded taxation schemes.

Increase the Current Feedstock Tax

Superfund revenues are currently derived from four major sources: excise taxes on petroleum and certain chemicals (the so-called feedstock tax); appropriations from the general fund of the U.S. Treasury; fines and cleanup cost recoveries; and interest earned on the fund balance (see Figure 3). Feedstock revenues clearly dominate the other revenue sources, ranging from $240 million to $260 million annually, depending on the level of industrial activity. The Internal Revenue Service estimates that current feedstock taxes are paid by about 500 companies. The 10 largest feedstock taxpayers, however, account for almost 50 percent of feedstock tax revenues. [22] The firms may recover some or all of these tax costs through product price increases.

Feedstock taxpayers argue that the current tax scheme is inequitable because the costs of Superfund cleanups are assessed only on petrochemical producers, even though many other industry groups generate hazardous

Figure 3.
Superfund Revenue Sources, 1981-1985



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[22] Joint Committee on Taxation, *Background and Issues* (1985).

waste. The original logic of the tax--in addition to its administrative simplicity and relatively stable tax base--was that the placing of a tax on the basic petrochemical "building blocks" would distribute the costs of waste cleanup throughout the chain of production, to the extent that producers could pass on the costs of the tax. By taxing current output, however, the feedstock tax--or the other types of taxes for that matter--might unfairly impose costs on firms that have not contributed to the current Superfund sites.

In addition, current feedstock taxpayers contend that the present tax has eroded their competitive position in the world marketplace. For example, foreign producers are not subject to such taxes unless their goods are sold in the United States. Imported chemical intermediates, which are produced from untaxed foreign-made feedstock chemicals, are not subject to any tax, although their domestic counterparts presumably reflect feedstock tax costs in final selling prices. Thus, further increases in feedstock taxes could harm U.S. exporters of feedstock materials or domestic producers of chemical intermediates. Doubling the current tax would provide roughly $500 million per year, but this increase probably would intensify the adverse economic effects of the tax for the chemical and petroleum industries. These industries are already among the most adversely affected groups under RCRA and the four alternative tax systems analyzed above.

Recent EPA and Congressional Research Service analyses dispute claims that current feedstock taxes have imposed a significant burden on U.S. producers. 23/ These studies note that any potential effects of Superfund feedstock taxes on the U.S. balance of trade are overshadowed by the effects of global recession, decontrol of U.S. crude oil prices, changes in exchange rates, and increases in the capacity of foreign chemical production. Although increasing feedstock tax rates could provide a continuing stable source of revenue for Superfund, doing so would also place U.S. feedstock exporters at a greater competitive disadvantage, especially for manufacturers of products such as ethylene derivatives. Current worldwide economic realities, which already encourage foreign investment in and production of petrochemicals, could work in combination with a feedstock tax to reduce petrochemical production in the United States.

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23. See U.S. Environmental Protection Agency, *The Impact of the CERCLA Tax on the Nation's Balance of Trade*, Section 301(a)(1)(F) Study (December 1984); and Congressional Research Service, *U.S. Primary Petrochemicals: The Superfund Taxes and Other Factors Shaping Recent Trends in Supply and Demand* (August 30, 1984).

Cost Recovery

Although the parties responsible for creating Superfund dump sites often cannot be identified or, if known, lack the necessary resources to pay for cleanups, the EPA has been able to recover Superfund cleanup expenditures from some culpable individuals or firms. Fines and recoveries have provided about $3 million annually over the last two years. The EPA hopes that more vigorous enforcement efforts will raise $32 million in fiscal year 1986, but CBO's estimate of the President's 1986 budget projects that fines and recoveries will total only about $25 million in that year. Cost recovery could become a more significant source of revenue in future years, however, as federal litigation cases (filed in the recent past) eventually come to trial or settlement. CBO's current budget baseline, therefore, projects that cost recovery efforts could provide $100 million annually to the Superfund beginning in the late 1980s.

Voluntary Contributions

Over the past five years, EPA has negotiated settlements, valued at about $310 million, with responsible parties for Superfund cleanup activities. Four settlements accounted for nearly half of this amount. Private chemical companies recently have attempted to institute voluntary cleanups of Superfund sites. Specifically, Clean Sites, Inc. was founded by a coalition of industry leaders and certain environmental groups to negotiate cleanup contributions from potentially responsible parties (without admission of legal culpability) and to clean up sites subject to EPA approval. Clean Sites has indicated that it eventually plans to work on about 60 sites a year, although total cleanup is probable at only about 10 sites per year.

Because no decision has been made to set minimum environmental standards for voluntary cleanups, the potential value of future settlements and voluntary cleanups is uncertain. In addition, existing "joint and several" liability provisions under Superfund might discourage settlements and voluntary remedies. If one responsible party wants to settle, that firm either must convince all other parties responsible for the hazardous site to settle or else pay a disproportionate share of restoration costs. It is unlikely, therefore, that settlements and voluntary cleanups could relieve more than a small portion of the Superfund burden. The CBO estimates that the potential Superfund contributions under this alternative would be about $40 million a year.

Corporate Receipts Tax

Several recent proposals would impose a flat tax on all U.S. companies whose net corporate receipts exceeded $5 million annually. [24] This approach could provide a reliable source of revenue by assessing a small tax on corporate domestic net receipts; about 46,000 companies, out of a total of 3.5 million, would be affected. Tax rates of $0.55 per $10,000 of net receipts would be sufficient to generate annual revenues of $100 million (see Table 28). Proponents argue that this type of tax would spread the costs of a national waste cleanup effort more equitably than the current feedstock tax, the brunt of which is borne by about 10 petrochemical companies. But taxing companies that do not produce hazardous wastes also might be inequitable. (Almost half of the firms subject to the tax would produce little or no hazardous wastes.)

TABLE 28. ANNUAL REVENUE POTENTIAL OF NET CORPORATE RECEIPTS TAX

Environmental Tax Rate (In percents) [a]	Tax Per $10,000 of Net Domestic Receipts (In 1983 dollars)	Annual Revenue Potential (In millions of 1983 dollars)
.0055	0.55	100
.0110	1.10	200
.0165	1.65	300
.0220	2.20	400
.0275	2.75	500
.0330	3.30	600
.0385	3.85	700
.0440	4.40	800
.0495	4.95	900
.0550	5.50	1,000

SOURCE: Congressional Budget Office, based on 1984 estimates prepared by the Joint Committee on Taxation.

a. Tax would apply to corporations' domestic net receipts above $5 million annually.

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[24] See, for example, Management Analysis Center, *Financing Superfund: An Analysis of CERCLA Taxes and Alternatives* (prepared for ARCO Chemical Company, June 1984). Also see S. 596, introduced by Senator Bradley, which proposed a tax of .0008 percent on net corporate receipts over $50 million in gross receipts.

General Revenues

The federal government currently contributes about $44 million annually to the Superfund cleanup effort. Because recent projections of future cleanup costs appear to exceed easily the revenue potential of the alternatives described above, an increase in the federal contribution has been suggested. Superfund appropriations might provide a more certain level of funding, without the administrative complexities of waste-end taxes or the potential inequities of a feedstock tax. Because no tax assessed now could provide a complete link to past polluters (even waste-end taxes are only an approximation of the "types" of activities for which Superfund is used), the use of general revenues would probably be the most equitable funding scheme for cleaning up hazardous waste sites. The use of general revenues could also be justified on the grounds that, because all consumers have benefited in the past because of lower product prices for waste-producing goods, society at large should finance necessary cleanup efforts. But the use of waste-end taxes (or even a feedstock tax to a lesser degree), while inequitable in some sense, would provide incentives for proper waste reduction and management, results that would not be achieved through the use of general revenues.

ADDITIONAL IMPROVEMENTS TO THE FEDERAL HAZARDOUS WASTE MANAGEMENT SYSTEM

The federal and state governments and private parties could undertake additional activities to address problems that might arise through implementing the 1984 RCRA amendments. These measures could be pursued regardless of whether the other major options outlined in this chapter were implemented. The problems potentially confronting industry and government include the following:

- The need for some industries to become aware of innovative waste control or waste reduction technologies and strategies;
- The possibility of treatment capacity shortages developing as the land disposal bans take effect;
- Difficulties facing small quantity waste generators entering the federal waste management system for the first time; and
- The continuing administrative and enforcement burden resting on the EPA under the RCRA framework.

Although the options reviewed below may not constitute waste management alternatives that can stand alone, they could greatly enhance any of the broader regulatory or economic incentive plans.

Accelerated Research, Development, and Information Transfer

In the 1984 amendments, the Congress reaffirmed RCRA's intent to promote waste reduction. Evidence shows, however, that this goal has not been supported by recent trends in research and development funding. An increase in EPA research funding has been accompanied by a shift in research and development priorities from emphasis on long-term health effects and new technology development to short-term programs to support directly promulgation of regulations. 25/ The EPA research and development budget for the solid and hazardous waste program increased from $16 million in fiscal year 1980 to $32 million in fiscal year 1981; and has remained in the $31 million to $33 million range through fiscal year 1985. A review of EPA research projects planned for completion by fiscal year 1986, however, reveals a focus on risk assessment, analytical methods for detection of chemicals, landfill and treatment performance, and performance standards for incinerators, all supporting imminent regulatory deadlines.

It could be desirable to expand research on new treatment technologies or materials recovery alternatives, similar to the kind performed by the Office of Recycled Materials in the Department of Commerce from 1977 through 1981. 26/ Such a program could develop and disseminate technical and economic information on industrial waste reduction. Research priorities could be set with the goals of EPA's programs in mind--the eventual land disposal bans, for example--but activities would not be associated with EPA's day-to-day regulatory activities. Funding could also be provided for waste-reduction research through industrial extension services at universities. A $5 million university support program could be funded solely through a waste-end tax of $0.02 per metric ton. This research could focus on treatment methods that no single generator could afford to examine. Such programs potentially could help to develop new waste reduction technologies, enabling the national waste generation total to fall below CBO's estimated low range of 229 MMT per year.

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25. See Congressional Budget Office, *The Budget of the Environmental Protection Agency: An Overview of Selected Proposals for 1985* (April 1984).

26. The National Research Council has recently called for expanded research and development in this area. See *Reducing Hazardous Waste Generation* (National Academy Press, 1984).

Taxing industry only to disburse funds for expanded private research and development might be considered inefficient, however. For example, one industry might be forced to subsidize another that lacks expertise in waste management. Opponents of federally funded research efforts also argue that such research and development should be the private sector's responsibility.

Ensuring Adequate Treatment Capacity

The full implementation of the 1984 RCRA amendments is expected to increase the demand for off-site treatment and disposal services from the current 10 million metric tons annually to between 17 MMT to 25 MMT in 1990. If no new facilities are built during this period, available off-site capacity would be exhausted quickly. Additional measures to ensure adequate treatment capacity, either on- or off-site, therefore might be useful.

Capital Formation Assistance. Under the 1984 RCRA amendments, an estimated 130,000 small generators of hazardous wastes will be included in the regulatory system for the first time. Such businesses may not be able to afford compliance with these new requirements, however. 27/ Providing low-cost capital assistance for small generators might help these firms institute waste reduction or other treatment measures, rather than pay taxes or attempt to avoid regulations. Encouraging on-site treatment by small generators would reduce incentives for poor waste management, especially if off-site management costs rise dramatically as demand increases and costly new technologies are instituted. In addition, on-site management would pose fewer potential risks of hazardous releases during waste transport.

A federally subsidized loan program could provide assistance to the newly regulated small generators. For example, a $300 million program could provide $10,000 each to 30,000 of these companies. If loans were made for 10 years at 5 percent interest, the federal government would incur about a $10 million loss each year from the interest subsidy. 28/ Additional

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27. See ICF, Inc., *An Estimate of Small Business Financing Needs to Comply with EPA Regulations* (prepared for Environmental Protection Agency, Small Business Ombudsman, September 7, 1983).

28. The current Treasury borrowing rate is about 8 percent. The difference between the cost of the government's borrowing rate and the 5 percent interest charged to waste generators would be the subsidy provided to small generator companies under such a program.

rapid depreciation and investment tax credit provisions for new equipment might also cost the government another $60 million annually in lost revenue. About $0.26 per metric ton in waste-end taxes, imposed on all hazardous wastes, would pay for the entire program, including the potential revenue loses.

Central Recovery/Mobile Treatment Facilities. Even if new facilities could be built to meet aggregate off-site treatment demand, it is possible that regional capacity bottlenecks could arise that would frustrate the goals of the 1984 RCRA amendments. Many of the firms affected could be small waste generators unable to invest in on-site treatment facilities. Provisions for such occurrences could be made either by developing central recovery or treatment stations or by providing similar mobile services to small firms. These efforts could be directly funded by the federal government (with costs presumably recovered through user fees) or supported by specialized permit procedures. [29]

Regional facilities (or mobile treatment services, if feasible) serving targeted industries could save money by taking advantage of economies of scale and by offering reasonable rates. One recent study of electroplating firms in five cities, for example, calculated an average annual savings in waste treatment costs of about $8,500 per plant with a centralized facility, compared with individual on-site treatment (see Table 29). These facilities could be publicly or privately held. In either case, encouraging their development would seem warranted if siting opposition appears to override strong economic demands for such facilities.

A Deposit/Refund System. A deposit/refund concept (similar to state "bottle-bill" legislation) could be used to ensure proper handling of "flow-through" type wastes, such as oils and solvents. These wastes are purchased, used in production, and depleted. Unlike other types of wastes, they are generally not a by-product of production. In addition, they are easily and, in most cases, economically recycled. A deposit/refund system would make improper handling of these wastes expensive, without the threat of or need for regulatory enforcement. To encourage recycling, a mandatory deposit would be placed on each gallon (or metric ton) of oil or solvent purchased. The deposit would be refunded only after the waste oil or spent solvent was

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29. See discussion of permits for mobile treatment by Senator Chafee, *Congressional Record* (October 5, 1984), pp. 13819-13820. Also see, James McCarthy and others, *Capacity To Expand the Superfund: Labs, Contractors, Qualified Personnel and Waste Management* (Congressional Research Service, April 2, 1985), p. 55.

returned to an authorized center.[30] This option would provide no net revenues to the administering state or federal government, unless product users failed to return the recyclable wastes. The deposit on halogenated solvents could be set at a higher rate than oil to reflect the relatively greater public health threat of improper handling of these substances.

Enhanced Enforcement

Strict enforcement will continue to be a critical component of any hazardous waste management policy that relies on a "command and control"

TABLE 29. A COMPARISON OF ELECTROPLATER'S WASTE TREATMENT COSTS WITH AND WITHOUT A CENTRALIZED TREATMENT FACILITY

		Total Annual Cost (In thousands of 1980 dollars)		Percent Saved with
Region	Number of Shops	Individual On-Site Treatment	Central Treatment Facility	Central Treatment Facilities
Cleveland	103	4,199	2,504	40.4
Philadelphia	90	3,170	2,778	12.4
Milwaukee	60	1,857	1,437	22.6
Atlanta	54	826	501	39.3
Seattle	60	708	525	25.8

SOURCE: Environmental Protection Agency, *Environmental Pollution Control Alternatives: Centralized Waste Treatment Alternatives for the Electroplating Industry* (Industrial Environmental Research Laboratory, Cincinnati, Ohio, June 1981).

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30. In many cases, such centers already exist. They are waste-oil haulers, collecting oil under contract to rerefiners or fuel blenders. Under this option, authorized centers could include these independent haulers, in-house return centers, or fuel blenders. For more information, see Association of Petroleum Rerefiners, *Used Oil, The Hidden Asset*, Proceedings of the Fourth International Conference on Used Oil Recovery and Reuse (1982).

approach. The 1984 amendments take into account the generally inadequate enforcement of RCRA since 1976 by mandating biennial inspections of all treatment, storage, and disposal facilities. But this raises one of the principal drawbacks of the command and control attitude embodied in the original RCRA and largely conserved in the 1984 amendments. Regulations that alter the private decisionmaking process, forcing a shift from least-cost technologies to more costly options, will invariably require, at a minimum, the perception of enforcement and penalties to make the process work.

The opposite perception has characterized industry's reaction to RCRA. The EPA has repeatedly delayed the issuance of enforceable standards and final permits to hazardous waste treatment, storage, and disposal facilities. Thus, even though the number of facility inspections increased by 14 percent in 1983, one recent study has found that more than 50 percent of hazardous waste facilities are still in violation of RCRA's groundwater monitoring requirements. 31/

Under the new law, enforcement will become an even more critical component of EPA's regulatory process. Facility standards established under RCRA have been maintained or strengthened in the 1984 act and new activities have been added that will make additional demands on the EPA and state enforcement agencies. Considering the magnitude of all these requirements, the EPA enforcement budget might need to be increased significantly. 32/ In fiscal year 1985, the EPA budget for hazardous waste enforcement is about $8 million, or roughly the same real level of spending as in 1980 (see Figure 4). Compared with real enforcement spending for water quality ($33 million per year since 1975) or air quality ($27 million per year since 1975), enforcement spending for the EPA hazardous waste program appears inadequate.

One way to increase state or federal enforcement activities without incurring increases in budget outlays would be to dedicate a portion of a waste-end tax to a stepped-up enforcement program. A very small tax--$0.10 per metric ton on all hazardous wastes--would raise about $27 million in revenues. This amount would bring hazardous waste program enforcement up to the level of enforcement of the air quality program. Co-

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31. General Accounting Office, *Inspection, Enforcement, and Permitting Activities at New Jersey and Tennessee Hazardous Waste Facilities* (June 22, 1984).

32. State enforcement efforts could relieve the EPA of some of its enforcement burden. On average, however, about 75 percent of state budgets for hazardous waste programs comes from federal grants. See Office of Technology Assessment, *Technologies and Management Strategies* (1983).

enforcement of the Clean Water Act and RCRA (as amended) could be another way to increase enforcement at low additional costs. Many industrial locations receive permits and are regulated under both acts, and joint inspection could accomplish more enforcement with little, if any, increase in combined program costs.

Figure 4.
Enforcement Budgets for EPA's Air, Water, and Hazardous Waste Programs, 1975-1985